Printed on Thin Paper for Foreign Circulation

SEP 13 1922

The Engineer.

Established 1856. Registered as a Newspaper.

OFFICE FOR ADVERTISEMENTS & PUBLICATION, 33, NORFOLK ST., STRAND, LONDON, W.C. 2.

VOL. CXXXIV.—No. 3478] LONDON: FRIDAY EVENING, AUGUST 25, 1922 [PRICE ONE SHILLING BY INLAND POST 1s. 3d.

PUBLIC NOTICES

The High Commissioner for India is prepared to receive TENDERS for the SUPPLY of :—

1. RAILS, 41½ lb. per yard, and FISH-PLATES.
2. LATHES, SLIDING, SURFACING and SCREW-CUTTING, and BRASS FINISHING.
3. CRANES, COALING, STEAM.
4. MACHINES, WEIGHING PLATFORM.
5. JACKS, SCREW, LIFTING and TRAVERSING.
6. ENGINES and BOILER for STERN-WHEEL STEAMER.

Forms of Tender may be obtained from the Director-General, India Store Department, Branch No. 15, Belvedere-road, Lambeth, S.E. 1, and Tenders are to be delivered at that office not later than Two o'clock p.m. on Friday, the 8th September, 1922, for No. 1, and on Friday, the 15th September, 1922, for Nos. 2 to 6.

T. RYAN,
Director-General.
57

Colombo Port Commission.
FOR SALE,
33-TON BLOCK SETTING TITAN,
Built by Messrs. Stothert and Pitt, Bath, England.

The machine is capable of lifting, lowering, racking in and out, slewing round the entire circle, and travelling with concrete blocks of 33 tons weight each, at a maximum radius, from the centre pivot of the machine, of 60ft. The Titan travels on 32 ground wheels running on two railways, the extreme rails of which are 25ft. apart, centre to centre; each railway is 5ft. 6in. gauge between the rails.

The machine is capable of the several motions at the following speeds :—

(a) Lifting with full load, 8ft. per minute.
Lifting with light load, 20ft. per minute.
(b) Travelling with full load suspended, 50ft. per minute.
(c) Racking carriage with full load suspended, 20ft. per minute.
Racking carriage without load, 50ft. per minute.
(d) Slewing motion, one complete revolution with full load suspended, in 3 minutes.

All motions are performed by steam, except the lowering of loads, which is controlled by "Matthews" patent hydraulic brake.

All machinery and working parts are in good order. A new steam boiler (vertical type) is required.

The steel structural work is generally in good order and has been regularly scaled and painted.

Further information may be obtained from the CROWN AGENTS FOR THE COLONIES, 4, Millbank, Westminster, S.W. 1, or from the HARBOUR ENGINEER, Colombo, Ceylon. 8924

City of Cardiff Education
COMMITTEE.
THE TECHNICAL COLLEGE.
PRINCIPAL, CHARLES COLES, B.Sc. (Lond.)
DEPARTMENT OF ENGINEERING.
HEAD OF DEPARTMENT, A. W. LOVERIDGE, B.Sc. (Eng.), A.R.C.Sc.
SESSION 1922-23
(Commencing on TUESDAY, 3rd OCTOBER, 1922).

The following COURSES have been arranged for ENGINEERING STUDENTS :—

A Three Years' Course in Mechanical and Marine Engineering, jointly with the University College of South Wales and Monmouthshire.

A Two Years' Course for Apprentices and others with facilities for practical experience in the Summer Term.

These Courses are suitable for Students preparing for Degrees in Engineering or for the Examinations of the Engineering Societies.

Special Courses are also arranged for Marine Engineers preparing for the Examinations of the Board of Trade.

For further particulars of Full-time and Part-time Courses, Entrance Examination, Scholarships, Fees, &c., apply to the Principal. Forms of application for admission to the Entrance Scholarship Examination, duly completed, must be received by the 14th September.

JOHN J. JACKSON,
Director of Education.
City Hall, Cardiff. 51

Crystal Palace School of
PRACTICAL ENGINEERING.
Founded 1872.
PRINCIPAL: J. W. WILSON, M.I.C.E., M.I. Mech. E.
The NEW COURSE will COMMENCE on SEPTEMBER 13, 1922. 53

University of Birmingham.
FACULTY OF SCIENCE.
ENGINEERING DEPARTMENTS.

I.—MECHANICAL ENGINEERING.
CHAIR PROFESSOR: F. W. BURSTALL, M.Sc., M.A. (Cantab), M. Inst. C.E., M. Inst. M.E.
LECTURER: R. C. PORTER, M.Sc. (Vict.), A.M. Inst. C.E.
DEMONSTRATOR: S. J. ELLIS, A.M.I.C.E.
LECTURER ON MACHINE DESIGN: F. H. BODEN.
ASSISTANT LECTURERS ON MACHINE DESIGN: HENRY BAKER, B.Sc.

II.—CIVIL ENGINEERING.
BEALE PROFESSOR: FREDERICK C. LEA, M.Sc., D.Sc. (Lond.), A.M.I.C.E., A.R.C.S.
LECTURERS: E. C. PANTON, M.Sc.; H. W. COULTAS, B.Sc.; (Vacant).
LECTURER ON TOWN PLANNING: W. HAYWOOD.

III.—ELECTRICAL ENGINEERING.
PROFESSOR: WILLIAM CRAMP, D.Sc.
LECTURER: E. J. KIPPS, M.Sc., M. Inst. E.E.
ASSISTANT LECTURERS AND DEMONSTRATORS: O. R. RANDALL, B.Sc.; H. VICKERS, M. Eng.; G. M. HARVEY, B. Eng.

The FULL COURSES EXTEND OVER FOUR YEARS, and students who enter after matriculation and pass successfully the Examinations at the end of each year will be ENTITLED to the DEGREE of BACHELOR of SCIENCE in Engineering.

THE SESSION 1922-23 COMMENCES ON OCTOBER 2nd, 1922.

For detailed syllabus of the Faculty with full particulars of University Regulations, Lecture and Laboratory Courses, Fees, &c., apply to the REGISTRAR. 8999

The Engineer

PRINCIPAL CONTENTS OF THIS ISSUE.

Chinese Engineering Notes.

A British Beet Sugar Factory—No. II.

The Sukkur Barrage.

Gas-driven Power Plant using Wood Fuel.

High Voltage Switch-gear Developments.

The Chlorination of Water.

Crystallisation.

Hulutao Harbour in Manchuria.

Position of the Shipbuilding Industry.

South African Electricity Bill.

PUBLIC NOTICES

The University of Sheffield.
SESSION 1922-23.
Vice-Chancellor: SIR HENRY HADOW, C.B.E., M.A., D.Mus.

DEPARTMENTS of MECHANICAL, ELECTRICAL and CIVIL ENGINEERING, METALLURGY, MINING, FUEL TECHNOLOGY and GLASS TECHNOLOGY.

PROFESSORS.
Mechanical Engineering.—W. RIPPER, C.B., D.Eng., D.Sc., M. Inst. C.E.
Metallurgy.—C. H. DESCH, D.Sc., Ph.D., F.I.C.
Civil Engineering.—J. HUSBAND, F.R.C.Sc.I., M.Eng., Assoc. M. Inst. C.E.
Mining.—D. HAY, B.Sc., Assoc. M. Inst. C.E.
Fuel Technology.—R. V. WHEELER, D.Sc., F.I.C.
Glass Technology.—W. E. S. TURNER, O.B.E., D.Sc., F. Inst. P.
Chemistry.—W. P. WYNNE, D.Sc., F.R.S., F.I.C.
Physics.—S. R. MILNER, D.Sc., F.R.S., F. Inst. P.
Geology.—W. G. FEARNSIDES, M.A.
Electrical Engineering.—E. H. CRAPPER, M. Eng., M.I.E.E. (Lecturer).
Mathematics.—C. A. STEWART, M.A. (Lecturer).

The Courses in the DEPARTMENT of ENGINEERING extend over three or four years and prepare students to become Mechanical, Electrical, Civil, or Mining Engineers, or specialists in Fuel Technology, or Glass Technology.

The Courses in the DEPARTMENT of METALLURGY cover a period of three or four years and prepare students for positions of responsibility either (1) in Iron and Steel Manufacture, or (2) in the Non-ferrous Metallurgical Industries.

The LECTURE COURSES in all the Departments are supplemented by Practical Training in Laboratories and Workshops, which are fully equipped for the purpose of advanced scientific teaching, investigation, and research.

Part-time Courses are arranged for students who desire to take special portions of any of the regular courses.

In Mining Engineering, and in certain of the Courses in Mechanical and Electrical Engineering, and in Glass Technology, arrangements are made to enable students, who come to the University from works or collieries, to take six months' courses of study at the University and six months' practice at the works or colliery each year for a period of four years.

The LECTURE COURSES commence OCTOBER 4th, 1922.

The TECHNICAL LABORATORY COURSES commence SEPTEMBER 26th, 1922.

For further details of the Courses and for particulars of the Degrees, Associateships, Diplomas and Certificates awarded on their successful completion, application should be made to

W. M. GIBBONS, Registrar.
9097

Auckland Harbour Board, New
ZEALAND.

TENDERS are INVITED for the SUPPLY and DELIVERY of :—
TWELVE (12) 5-Ton (and alternatively for 3-Ton) Semi-portal Balanced JIB ELECTRIC QUAY CRANES.
FOUR (4) 5-Ton (and alternatively for 3-Ton) Balanced Jib ELECTRIC ROOF CRANES.
SIX (6) 1-Ton ELECTRIC MONO-RAIL CRANES.

Specifications, diagrams and forms of Tender can be obtained at the office of the Board's Agents,
Messrs. W. and A. McArthur, Ltd.,
16/19, Silk-street,
Cripplegate, London, E.C. 2,
on payment of a deposit (returnable) of Two Guineas.

Tenders to reach Auckland by Noon on February 1st, 1923, addressed "The CHAIRMAN, Harbour Board, Auckland, New Zealand." 9003

PUBLIC NOTICES

County of London Electric
SUPPLY CO., LTD.
BARKING POWER STATION.

The County of London Electric Supply Company, Ltd., are open to receive TENDERS for the SUPPLY and ERECTION of STEAM TURBO-ALTERNATORS for their Barking Power Station. Specifications may be obtained by turbine manufacturers from the offices of the Company on application to the undersigned on or after August 25th and on payment of a fee of Five Guineas for the first copy and Two Guineas for every subsequent copy. Sealed Tenders, marked "Tenders for Turbo-alternators for Barking Power Station," are to be addressed to the undersigned and lodged at the Registered Office of the Company by Noon on October 18th, 1922. Sums paid for any number of copies up to three will be refunded on receipt of a bona fide Tender. The Company do not bind themselves to accept the lowest or any Tender.

F. C. McQUOWN,
Manager and Secretary,
The County of London Electric Supply Co., Ltd.,
Moorgate-court, Moorgate-place, E.C. 2. 74

Liverpool Corporation Water-
WORKS.
NEW TRUNK MAIN FROM PRESCOT.—CONTRACT NO. 2.
PIPE LAYING.

The Water Committee of the Liverpool Corporation are prepared to receive TENDERS from competent persons willing to enter into a Contract for the LAYING of CAST IRON PIPES of 42in. and 40in. internal diameter and other ancillary WORKS, as follows, viz.:

From the PRESCOT RESERVOIRS of the Liverpool Corporation to RATHBONE-ROAD, LIVERPOOL, in the County of Lancaster, for a distance of about 6 miles.

The plans and sections may be inspected and copies of the specification and form of Tender obtained on and after Monday, the 28th August, 1922, at the Water Engineer's Office, Alexandra Buildings, 55, Dale-street, Liverpool, upon payment of the sum of Five Guineas, which amount will be returned upon receipt of a bona fide Tender.

Tenders, endorsed "Tender for Pipe Laying," are to be sent through the post, in a sealed envelope, addressed "Chairman of the Water Committee, Town Clerk's Office, Municipal Buildings, Liverpool," so as to be delivered not later than Twelve o'clock Noon on Tuesday, the 19th September, 1922.

The Water Committee do not bind themselves to accept the lowest or any other Tender.

G. HAMMOND ETHERTON,
Town Clerk.
Municipal Buildings, Liverpool,
25th August, 1922. 77

Manchester Corporation Water-
WORKS.
HYDRAULIC POWER SUPPLY.

The Waterworks Committee invite TENDERS for ONE ELECTRICALLY DRIVEN AIR COMPRESSOR.

Specification and form of Tender may be obtained on application to the Secretary, Waterworks Offices, Town Hall, Manchester, on payment of Two Guineas, which sum will be returned on receipt of a bona fide Tender.

Extra copies of the specification may be obtained on payment of 10s. 6d. per copy.

Any other information required respecting the work will be furnished by the WATER ENGINEER, Town Hall, Manchester.

Tenders must be delivered not later than the 9th September, 1922. 68

Tenders Wanted for Erecting
a 10-TON TITAN CRANE in South Wales. Weight about 100 tons.—For particulars apply to GEO. COHEN SONS and CO.,
55 600, Commercial-road, E. 14, London.

PUBLIC NOTICES

East Indian Railway.

The Directors are prepared to receive up to Eleven o'clock a.m. on Wednesday, the 6th September proximo, TENDERS for the SUPPLY of :—
METALS (Antimony, Brass and Copper Sheets, Rods, Wire and Tubes, and Lead and Zinc Sheets).

Copies of the specification can be obtained at the Company's Offices on payment of £1 1s. each. This fee will not be returned.

G. E. LILLIE,
Secretary.
73-76, King William-street,
London, E.C. 4.
23rd August, 1922. 63

State Electricity Commission
OF VICTORIA.
TENDERS FOR PLANT.

TENDERS are hereby INVITED for the SUPPLY, DELIVERY, &c., of the following for the Morwell Power Scheme.

Copies of Tender form and specification will be available upon application to—
Agent-General for Victoria,
Melbourne-place, Strand,
London, W.C. 2.

SPECIFICATION NO. 282.—COAL-HANDLING PLANT FOR MORWELL POWER STATION AND BRIQUETTING WORKS.

CHARGE.—£2 2s. for the first two copies of Tender form, conditions of contract, specification and drawings complete. These charges will be returned on receipt of a bona fide Tender. A third copy and any further copies will be supplied for the sum of £1 1s. each.

PRELIMINARY DEPOSIT.—A preliminary deposit of £50 is to be lodged with Tender.

The specifications may be inspected at the above-mentioned office.

The Commission does not bind itself to accept the lowest or any Tender.

Tenders, on prescribed form, properly endorsed and addressed, must be delivered to the undersigned in Melbourne not later than 5 p.m., 18th December, 1922.

R. LIDDELOW, Secretary,
State Electricity Commission of Victoria.
60 Melbourne, Victoria, Australia.

The South Indian Railway Com-
PANY, Limited, are prepared to receive TENDERS for the SUPPLY of :—
1. 46 METRE-GAUGE LOCOMOTIVES and 6 LOCOMOTIVE BOILERS.
2. 108 METRE-GAUGE WAGONS.
3. BRIDGEWORK.

Specifications and forms of Tender will be available on Monday, the 28th August, 1922, at the Company's Offices, 91, Petty France, Westminster, S.W. 1.

Tenders, addressed to the Chairman and Directors of the South Indian Railway Company, Limited, marked "Tenders for Locomotives," or as the case may be, must be left with the undersigned not later than Twelve Noon on Wednesday, the 4th October, 1922.

The Directors do not bind themselves to accept the lowest or any Tender.

A charge, which will not be returned, will be made of £2 for each copy of Specification No. 1, and £1 for each copy of Specifications Nos. 2 and 3.

Copies of the drawings may be obtained at the office of Messrs. E. White and Partners, Consulting Engineers to the Company, 3, Victoria-street, Westminster, S.W. 1.

A. MUIRHEAD,
Managing Director.
91, Petty France, S.W. 1,
24th August, 1922. 94

The Swanage Urban District
COUNCIL INVITE APPLICATIONS for the APPOINTMENT as FITTER-DRIVER-IN-CHARGE of their Waterworks.
For Lists of duties send stamped envelope.—
FRED. B. GOODMAN,
9069 Engineer.

SITUATIONS OPEN

Ref. 1872.

A THOROUGHLY TRAINED MECHANICAL ENGINEER.—The above is REQUIRED to fill the post of VICE-PRINCIPAL in an Educational Work-shop in India. The concern, though State-owned, is run on thoroughly commercial lines, undertaking both manufacturing and jobbing work. Apprentices will be given half a day shop work and half a day schooling; 500 to 600 boys will undergo training at once. The applicant will be required to have a thoroughly practical knowledge of all work in a mechanical work-shop, so as to be able to overlook and guide the instructions given. Salary offered will be £650, rising to £800, with chances of further promotion, depending upon the success of the undertaking. The incumbent will be expected to pass a higher grade in Urdu within two years of his arrival in India. He will be provided with house allowance or free quarters. Second-class return passage will be paid in case of his services being dispensed with in or before three years.—Applications, in writing, with copies of testimonials, to be sent to 79, The Engineer Office. 79 A

SITUATIONS OPEN—(continued) Page II.

SITUATIONS WANTED, Page 2.
PARTNERSHIPS, Page 2.
PATENTS, Page 3.
MACHINERY, &c., WANTED, Page 4.
FOR SALE, Pages and 4.
AUCTIONS, Page 102.
PREMISES TO LET OR WANTED, Page 102.
WORK WANTED, Page 3.
AGENCIES, Page 7.
MISCELLANEOUS, Page 2.

For Advertisement Rates See Page 195, Col. 1.

NUMERICAL INDEX TO ADVERTISEMENTS Page 101.

SITUATIONS OPEN (continued)

ASSISTANT, YOUNG UNMARRIED, ENGINEERS FOR INDIA (NORTHERN BENGAL).

WANTED, ENGINEER, with Knowledge of Veneer Lathes, Drag Saws, &c., and some Knowledge of Ply Wood Manufacture. Also ENGINEER for Sawmill; must be a good Saw Setter. Salaries, about Rupees 500 per month, with quarters.—Apply, with copies of reference, age, and experience, "PLYWOOD," Deacon's Advertising Agency, 7, Leadenhall-street, E.C. 3. 96 A

ASSISTANT TRAVELLER REQUIRED by a Firm of Constructional Engineers for their London office; one with practical experience preferred and good connection. State age, experience, references and salary.—Address, P5971, The Engineer Office. P5971 A

ENGINEER ASSISTANTS for Tea Gardens in Assam. Well-educated young men who have served full apprenticeship in engineering shops with knowledge of Internal Combustion Engines.—Write, with full particulars, to Box B.F.K., c/o Davies and Co., 95, Bishopsgate, E.C. 2. 95 A

ENGINEER.—WANTED by a London Engineering concern with works in the provinces, an ENGINEER for a position of responsibility in the works. Applicants must have had first-class practical experience in Electrical Engineering as applied to the manufacture of large types of electrical apparatus, backed up by sound technical knowledge. The position offers scope for the right man, and only those who are really qualified to fill the vacancy should apply. Applications, which will be treated in confidence, should state age, experience and qualifications, positions held, and salary required.—Address, 54, The Engineer Office. 54 A

TURBINE DESIGNER.—WANTED by a Large London Firm with works in the provinces, an experienced and competent TURBINE DESIGNER. Applicants must have had university or equal training, with actual experience in the design of modern Turbines. None but fully qualified men need apply. Applications (which will be treated in confidence) should state age, experience, qualifications, positions already held, and salary required.—Address, 54, The Engineer Office. 54 A

LEADING CYCLE and MOTOR CYCLE COMPANY REQUIRES competent WORKS MANAGER, having thorough experience of all departments of cycle and motor cycle manufacture; design, organisation, production, control of staff. Financial interest acceptable, but not essential. Remunerative position for qualified man. Write in strict confidence, with all details.—Address, 28, The Engineer Office. 28 A

REQUIRED IMMEDIATELY, the SERVICES of a GENTLEMAN with a really good connection amongst shipbuilding and repairing yards in the United Kingdom and who is sufficiently well acquainted with the marine superintendent engineers to be able to secure business through his influence in these quarters. Applicants are invited to state fully their qualifications to fill the position satisfactorily, and it is requested that applications shall not be made except by fully qualified gentlemen who are already doing business in the direction indicated. The remuneration and future prospects will depend entirely upon the candidate himself. Interviews will be arranged in London. All information supplied will be treated in strict confidence.—Address, "SHIPBUILDERS," care Deacon's Advertising Offices, Leadenhall-street, London. 97 A

YOUNG and Fully Qualified MECHANICAL ENGINEER REQUIRED to Control Technical Stores and Assist Chief Engineer of Large Plant in Central Africa. Sound practical and theoretical experience and good education essential. Knowledge of French an advantage. Experience, salary expected and age, which should not exceed 30 or 32.—Address, P5958, The Engineer Office. P5958 A

WANTED, ONE STEAM CRANE DRAUGHTSMAN; also ONE WINCH and WINDLASS DRAUGHTSMAN; each to be thoroughly experienced. Only first-class men need apply. State age, experience, and salary required, and when at liberty.—JOHN H. WILSON and CO., Ltd., Dock-road, Birkenhead. 78 A

DRAUGHTSMAN REQUIRED by Large Engineering concern for extra high-pressure Switchgear. Must be neat, quick, accurate, and fully conversant with modern switchgear arrangements for voltages of over 25,000. State age, training, experience, and salary required.—Address, 37, The Engineer Office. 37 A

DRAUGHTSMAN REQUIRED by Large Engineering concern, fully experienced in the detailing of Machine Parts. Must be neat, quick, and accurate. State age, training, experience, and salary required.—Address, 38, The Engineer Office. 38 A

DRAUGHTSMAN REQUIRED, North-East Coast. Must be thoroughly competent on all classes of Structural Work and Bridge Work; age 26 to 40. Full particulars, stating salary required.—Address, 8775, The Engineer Office. 8775 A

DRAUGHTSMAN WANTED, a Really High-class man, for Screening and General Colliery Plant. Must have had substantial experience with recognised manufacturers and be competent to design such plants throughout, or application useless. State age, experience, and salary required.—REES and KIRBY, Ltd., Morriston, Swansea. P5957 A

DRAUGHTSMAN WANTED for London District; must have had previous experience in making shop details of Construction Steel Work. State age, qualifications, and salary expected.—Address, 90, The Engineer Office. 90 A

ELECTRIC CRANE DRAUGHTSMAN, Also MALE and FEMALE TRACERS WANTED by the WELLMAN, SMITH, OWEN ENGINEERING CORPORATION, Limited, Darlaston.—Application to be made by letter, stating age, experience, and salary required. 56 A

EXPERIENCED DRAUGHTSMAN REQUIRED IMMEDIATELY, Manchester district, General and Heavy Mechanical Engineering. Must be fully competent to do all technical calculations, plant layout and design. State age, experience, and salary required.—Address, 86, The Engineer Office. 86 A

RELIABLE DRAUGHTSMAN REQUIRED with previous experience in Crane Trade; also ONE with previous experience of Excavating Machinery. Must be quick and accurate. State age, experience, and salary required.—TAYLOR and HUBBARD, Leicester. 82 A

REQUIRED, First-class DRAUGHTSMAN, Experienced in arrangements and details of Coal Crushing, Handling and Screening Plants for collieries.—Write, stating experience, age, and salary required, to D. L., c/o J. W. Vickers and Co., Ltd., 5, Nicholas-lane, E.C. 4. 82 A

THE METROPOLITAN CARRIAGE, WAGON and FINANCE CO., Ltd., Birmingham, REQUIRE an experienced DRAUGHTSMAN in Railway Carriage and Wagon Work and also Steel Car Design.—Apply by letter, stating experience, age, and salary required. 14 A

WEST LONDON ENGINEERS REQUIRE Experienced MECHANICAL DRAUGHTSMAN, accustomed to High-speed Engine and Turbine Design and General Lay-outs. First-class testimonials. State full particulars.—Address, 63, The Engineer Office. 63 A

SITUATIONS OPEN (continued)

FOUNDRY FOREMAN, Experienced in Iron and Small Steel Castings from "Stock" Converter. Must be thoroughly reliable, good organiser, and up-to-date man.—Address full particulars, stating salary required, 103, The Engineer Office. 103 A

MACHINE SHOP FOREMAN WANTED for General Engineering Works, Glasgow district. Only live men with up-to-date experience, initiative and ability need apply. Knowledge of production costs essential.—Address, stating age, experience, and salary expected, also give references to former employers, 61, The Engineer Office. 61 A

TOOL-ROOM FOREMAN.—WANTED, Exceptionally experienced MAN. Must be intimate with the theory of Gearing and possess wide experience of up-to-date manufacture of Gear Cutters, Worm Hobbing Cutters, Jigs and Fixtures for high-class gear unit production on up-to-date lines. State qualifications, age, give reference of similar position successfully held, wages required.—DAVID BROWN and SONS (Huddrs.), Ltd., Park Works, Lockwood, Huddersfield. 89 A

ERECTOR REQUIRED; a Good Reliable Man, accustomed to Erecting and Riveting up Large Oil Storage Tanks on contract.—Address, P5943, The Engineer Office. P5943 A

REFRIGERATION.—ERECTORS REQUIRED with outdoor experience in erecting and running the above plants.—Write, stating age, previous experience, and copies of references, to Box 605, Sell's Advertising Offices, Fleet-street, E.C. 4. 65 A

PATTERNMAKER, Experienced, WANTED for Brazil. Healthy climate. Good terms.—Apply by letter, stating age and experience, to "D. R.," c/o Reynell's, 44, Chancery-lane, W.C. 2. 70 A

SITUATIONS WANTED

AS WORKS MANAGER, ENGINEER with Sound shop and drawing-office experience in loco., steam, general engineering, millwrighting, ironfoundry and repair work; good organiser, firm and tactful control of labour, thorough knowledge of bonus, costing systems and economical production. Excellent long-service references.—Address, P5825, The Engineer Office. P5825 B

BUYER.—The MANAGER of a Large Engineering Works Purchasing Dept., who has an exceptionally wide knowledge of the Markets of the country, DESIRES to NEGOTIATE NEW APPOINTMENT.—Write, Z. M. 613, c/o Deacon's, Leadenhall-st., E.C. 85 B

A THOROUGH All-round MECHANICAL ENGINEER, in the capacity of Head Machine Shop Foreman, SEEKS similar APPOINTMENT; good workshop organiser, accustomed to up-to-date methods for both mass production of general engineering and handling large staff. No reasonable offer refused, either home or abroad.—Address, P5906, The Engineer Office. P5906 B

ENGINEER and BOILERMAKER, 20 Years' Experience, SEEKS POST; accustomed to boilers all makes and repairs, also constructional work, technical and commercial side of engineering.—Address, P4938, The Engineer Office. P4938 B

ENGINEER, 30 Years, with Sound Technical Training and good experience in all branches of engineering, steam and electrical plant, gas and chemical plant, constructional work, designing, draughtsmanship, chemistry, fuels and surveying, good linguist, keen, energetic and hard-working, DESIRES POST in Engineering Works or with Consulting Engineers at home or abroad.—Address, P5954, The Engineer Office. P5954 B

ENGINEER (32), Single, DESIRES POST, Home or abroad. Late shop superintendent with firm engaged on aero-engine manufacture and speciality trades. Charge of all depts. from foundry to D.O. Practical and technical. Strict disciplinarian; member of F.M.B.S.—Address, P5952, The Engineer Office. P5952 B

ENGINEER (33), Ex-officer, Mechanical and Electrical, DESIRES POST as Maintenance or Assistant Works Engineer; sound shop and D.O. experience in general engineering, repair work, sheet, plate glass, and bottle works.—Address, P5948, The Engineer Office. P5948 B

ENGINEERING EMPLOYERS

DESIROUS OF

OBTAINING THE SERVICES OF

EXPERIENCED & QUALIFIED FOREMEN,

having expert knowledge and supervisory abilities, should address 9050, The Engineer Office. 9050 B

FIRM of ENGINEERING CONTRACTORS are WILLING to TAKE ARTICLED PUPILS. Please communicate.—Address, 100, The Engineer Office. 100 E

FIRST-CLASS MACHINIST, Machine Tool Demonstrator, SEEKS POST, any capacity, home or abroad; used travelling, knows Canada well; technically trained; moderate salary.—Address, P5956, The Engineer Office. P5956 B

FOUNDRY AND PATTERN SHOP MANAGER.—ADVERTISER, age 37, 22 years' experience of marine, motor, hydraulic and general engineering, modern foundry and cupola practice, estimates, weights, works sketches, patterns, 5 years foundry manager, 6 years foreman pattern maker, DESIRES ENGAGEMENT, any capacity; good references.—Address, P5899, The Engineer Office. P5899 B

MECHANICAL ENGINEER, Aged 34, Extra 1st class B.O.T. certificate, shops and drawing-office experience, 3 years chief engineer refrigerating and passenger ships, 11 years assist. supt. engineer to shipping company, SEEKS APPOINTMENT in responsible position.—Address, P5909, The Engineer Office. P5909 B

MECHANICAL ENGINEER (25) DESIRES POSITION as ASSISTANT or on commercial side; 7 years' practical, including 5 years' apprenticeship with well-known firm, 2 years' technical.—Address, P5798, The Engineer Office. P5798 B

M. INST. C.E., Experienced in Railway Survey and construction, also waterworks design and construction, SEEKS POSITION as Resident Engineer or Agent.—Address, P5865, The Engineer Office. P5865 B

MOTOR and GENERAL ENGINEER, 3 Years works manager important acetylene welding firm, expert costing, works management and organisation, SEEKS EMPLOYMENT in similar capacity. Good education and war record and first-class testimonials.—Address, P5907, The Engineer Office. P5907 B

OPENING REQD.: Hons. B.Sc. Lond. (27). Any capacity; design, D.O., surveying, French; 3 yrs. comm. exp.; exc. tests.—S. WRIGHT, 102, Elsley-road, Lavender-hill, S.W. P5955 B

REPRESENTATIVE.—ENGINEER, Civil and Mechanical, DESIRES to obtain POSITION as above; unexceptional references, having held confidential appointments, consultant, administrative; thorough knowledge of engineering machinery, tools, plant, and materials.—Address, P5970, The Engineer Office. P5970 B

SALES ENGINEER.—REQUIRED, POSITION as above or similar Commercial Post, by B.Sc., civil and mechanical engineering, 21 years of age. Excellent references.—Address, P5947, The Engineer Office. P5947 B

SITUATIONS WANTED (continued)

SIT, REQD. as Boiler Inspector or Assistant to Boiler Engineer. Practical experience of construction, working conditions and inspection of steam boilers.—Address, P5951, The Engineer Office. P5951 B

SUCCESSFUL WORKS SUPERINTENDENT SEEKS CHANGE, either as Supt. or Assistant Works Manager, General or Locomotive; the latter preferred. Good organiser and disciplinarian; thorough knowledge of economical production.—Address, 91, The Engineer Office. 91 B

THE HEADS of the ENGINEERING PROFESSION are under an OBLIGATION to the younger generation; the REPUTATION of British Engineering is in its hands. I AM one of the younger generation and DESIRE an OUTLET for my ABILITY and CAPACITY for hard work. Age 22½. Engineering diploma—mechanical.—Address, P5963, The Engineer Office. P5963 B

YOUNG MAN (21) SEEKS APPOINTMENT with Engineering Firm. Would prefer sales and business department. Educated Marlborough and Clare, Cambridge; 1st Class Honours Degree Engineering Tripos (1922), 1st Class Maths. Tripos, Part I. (1920).—Address, P5940, The Engineer Office. P5940 B

YOUNG MAN (22), Diplomas in Civil and Electrical, ex-R.N.V.B., SEEKS POSITION with Firm of Civil Engineers or Contractors with view to serving them abroad when sufficiently experienced.—Address, P5942, The Engineer Office. P5942 B

YOUNG MAN (24), B.Sc. (Lond.), 5 Years in Shops, DESIRES SITUATION with Mechanical or Motor Engineers. Refs.—Address, P5929, The Engineer Office. P5929 B

YOUNG MECHANICAL ENGINEER, Works, Design and commercial experience, with office in Chancery-lane, WISHES to UNDERTAKE REPRESENTATION of Engineering Firm.—Address, P5944, The Engineer Office. P5944 B

DRAUGHTSMAN (Advanced Junior); 7 Years' experience, accustomed to jig, tool, machine work and detailing, &c.; workshop and technical training.—W. GREEN, 562, Barking-road, Plaistow, London, E. 13. P5965 B

DRAUGHTSMAN DESIRES EMPLOYMENT; 15 years rolling vehicle design, mechanical details and general engineering; age 30.—Address, P5968, The Engineer Office. P5968 B

JIG and TOOL DRAUGHTSMAN (35) DESIRES ENGAGEMENT. Free to commence immediately.—G., 54, Macoma-road, Plumstead, S.E. 18. P5946 B

FOREMAN, Fitting and Machining, SEEKS Similar POSITION; petrol engines, jigs, tools, fixtures, repetition work a recommendation.—Address, P5901, The Engineer Office. P5901 B

LAD (18) REQUIRES SIT, in Gen. Eng. Shops; 2 yrs. tech. coll., 3 yrs. D.O. and shops exp. London dist.—SHERLOCK, Laburnum Villa, Sudbury, Middx. P5939 B

PARTNERSHIPS

ENGINEERING PARTNERSHIPS AND BUSINESSES.

Wheatley Kirk, Price & Co.,

46, Watling Street, London, E.C. 4.

Established seventy years.

AN ACTIVE PARTNER is Immediately REQUIRED by a Consulting Engineer whose offices are situated in the City. It is essential that his qualifications must include drawing-office experience and a thorough knowledge of the engineering trade as a whole, preferably small tool work, the treatment of steel, and one who is not afraid to lend his hand on the board from time to time if necessary. The business requires little working capital, as the overhead charges are extremely low, and the proposition being one of a highly confidential nature, one who has been taught to be cautious will take preference over any other. The price for coming in is £500, half of which must be in immediate cash and the remainder as security. Solicitors, friends of the family, agents, and such others need not waste three-halfpence.—Address in the first place, P5833, The Engineer Office. P5833 C

WELL-KNOWN FIRM, with Excellent Prospects, REQUIRES PRACTICAL ENGINEER as PARTNER, with £2000 capital, for extensions; must be willing to take charge of works.—Address, stating age and experience, P5931, The Engineer Office. P5931 C

AGENCIES

AGENCIES WANTED.—YOUNG ENGINEER, Aged 30, DESIRES good AGENCIES for Scotland. Energetic, good connection, good address, best of references. Thorough knowledge engineering in all its branches, with experience in salesmanship. At present in permanent position, but wants greater scope on own account.—Address, P5962, The Engineer Office. P5962 D

AGENTS WANTED for SELLING CASE-HARDENING COMPOUND.—Address, stating age and experience and terms required, P5950, The Engineer Office. P5950 D

AGENTS WANTED, with Influence Amongst Steam users, to introduce Lancashire firm of boiler and steam pipe coverers. Good commission.—Address, P5691, The Engineer Office. P5691 D

ALFRED HERBERT LTD.

COVENTRY, ENGLAND.

We possess exceptional facilities for the sale of Engineering Goods of every description throughout the world and are prepared to negotiate for sole agencies.

We and our Associated Companies have offices and, in many cases, showrooms in the following territories:

ENGLAND—Coventry, London, Birmingham, Newcastle, Manchester, Sheffield, Leeds, Bristol.
SCOTLAND—Glasgow.
FRANCE—Soc. Anon. Alfred Herbert: Paris, Lyons, Lille.
BELGIUM—Soc. Anon. Belge Alfred Herbert: Brussels.
INDIA—Alfred Herbert (India), Ltd.: Calcutta, Bombay, Madras, Lahore, Rangoon.
ITALY—Soc. Anon. Ital. Alfred Herbert: Milan.
AUSTRALIA—Alfred Herbert (Australasia), Ltd.: Sydney.
JAPAN—Yokohama, Tokio, Osaka.
CANADA—Toronto. 82 D

AMERICAN ENGINEERS, Manufacturing Large range of oil burners and heaters, rivet forges, acetylene welding plant, carbide lights, paint sprayers, &c., REQUIRE SOLE AGENT for British Empire. Only firms of standing having first-rate connection to apply.—Address, 47, The Engineer Office. 47 D

AGENCIES.

ONE or TWO Good AGENCIES WANTED to Add to present business, or would manage London office; 10 years' sales management.—HENRY BRICE, 80, Brigstock-road, Thornton Heath. P5937 D

REPRESENTATION.—PARTNER of an Established Firm of Engineers in Burma, at present in this country, DESIRES to NEGOTIATE with Engineering Firms for their AGENCY in that district; Boilers, Engines, Pumps, Rice Mill and Sawmill Machinery, Industrial Machinery and Engineering Requisites.
Address, P5917, The Engineer Office. P5917 D

REPRESENTATION.—A Well-known FIRM of ENGINEERS and EXPORTERS with connections in South Africa and offices in Westminster, would be pleased to act as AGENTS for ENGINEERING FIRMS desirous of extending their business.—Address, 8655, The Engineer Office. 8655 D

EDUCATIONAL

CORRESPONDENCE COURSES for Inst. C.E., Inst. Mech. E., London Univ. (Matric., Inter., and B.Sc.) personally conducted by Mr. TREVOR W. PHILLIPS, B.Sc. (Honours), Assoc. M. Inst. C.E., M.R.S.I., F.R.S.A., &c. Also Day Tuition in Office. Excellent results at all Exams. Courses may commence at any time.—8/11, Trafford Chambers, 58 South John-street, LIVERPOOL. Ex.

INST. C.E., Inst. Mech. E., B.Sc., and all ENGINEERING EXAMINATIONS.—Mr. G. P. KNOWLES, M.B.E., B.Sc., A.M. Inst. C.E., &c., personally PREPARES CANDIDATES, either orally or by correspondence. Thousands of successes during the past sixteen years. Courses can be commenced at any time.—99, Victoria-street, Westminster, S.W. Telephone No., Victoria 4788. Ex.

LEARN SURVEYING AND LEVELLING.—Thorough practical instruction given by an expert.—Address, E. MOUL (late L.S.W. and S.P.D. Rlys.) Hollybank, Woking. P5937 B

MISCELLANEOUS

WANTED, COMMUNICATION RAILWAY COMPANIES or others interested in GOODS TRAIN CONTROL BRAKE.—Address, P5964, The Engineer Office. P5964 I

A FIRM, Equipped with Complete Modern Plant for executing small high-class mechanical work, SEEKS INQUIRIES. Suitable work would be undertaken at the smallest margin of profit in order to keep expert mechanics together.—Apply, THE BELL PUNCH and PRINTING CO., Ltd., 62/8, Tabernacle-street, Finsbury, E.C. 2. P5945 I

CONSULTING ENGINEER, A.M.I.C.E., A.M.I.M.E., 14 years' practical experience of machinery and plant of all kinds, is OPEN to ADVISE CLIENTS, preferably London area.—Address, P5941, The Engineer Office. P5941 I

CHINESE MARKET BEST FOR BRITISH GOODS.—ENGLISH ADVERTISEMENTS, DOCUMENTS, PAMPHLETS, &c., TRANSLATED into CHINESE and vice versa with promptitude and at reasonable terms by experienced writer in both languages.—Write, Mr. Z. L. YIH, 42, Baker-street, King's Cross-road, W.C. P5933 I

IMPORTANT TO LIVE ENGINEERS.—The PROPRIETOR of the BRITISH and FOREIGN RIGHTS of PATENT No. 141,144/1919 invites the keenest ANALYSIS of the same, as by this unique movement he claims a creation of power for every revolution of the shaft. Principals, open to finance same, can see a model demonstrating its commercial utility. (By appointment only.)—SMEDLEY, 30, Furnival-street, Crewe. P5911 I

TO ENGINEERING AND ALLIED TRADES.—A FIRM with well-equipped works near Glasgow, manufacturing Engineering Specialties, forgings, pressings, &c. &c. and having ample railway siding accommodation and room for extension, would CONSIDER AMALGAMATION with another firm manufacturing engineering or allied products and desiring to reduce present costs.—Apply to Messrs. MARTIN, MACKAY and MACQUAKER, 149, St. Vincent-street, Glasgow. P5955 I

TRANSLATIONS (French, German and Dutch) Accuracy and prompt service.—E. SWIFT, 50, St. Bees-street, Moss Side, Manchester. Many years' experience in engineering trade. P5633 I

PATENTS

THE PROPRIETORS of LETTERS PATENT No. 18,830/1913, relating to

"INTERNAL COMBUSTION ENGINES,"

DESIRE to DISPOSE of their PATENT or to GRANT LICENCES to interested parties on reasonable terms with a view to the adequate working of the patent in this country.—Inquiries to be addressed to

CRUIKSHANK and FAIRWEATHER,

65-66, Chancery-lane, London, W.C. 2. 9078 H

THE PROPRIETOR of LETTERS PATENT No. 110,352, relating to

"INDICATING DEVICES FOR DIMENSION-MEASURING APPARATUS AND MEASURING TOOLS,"

DESIRES to DISPOSE of his PATENT or to GRANT LICENCES to interested parties on reasonable terms with a view to the adequate working of the patent in this country.—Inquiries to be addressed to

CRUIKSHANK and FAIRWEATHER,

65-66, Chancery-lane, London, W.C. 2. 9092 H

THE PROPRIETOR of BRITISH PATENT No. 134,263, dated September 26, 1918, relating to "Improvements in Compression Refrigerating Machines," is DESIROUS of ENTERING into ARRANGEMENTS by way of a LICENCE or otherwise on reasonable terms for the purpose of EXPLOITING the above patent and ensuring its practical working in Great Britain.—All inquiries to be addressed, B. SINGER, Steger Building, Chicago, Illinois. 9093 H

THE PROPRIETOR of BRITISH PATENT No. 18,958/11, dated August 23, 1911, relating to "Cash Register," is DESIROUS of ENTERING into ARRANGEMENTS by way of a LICENCE or otherwise on reasonable terms for the purpose of EXPLOITING the above Patent and ensuring its practical working in Great Britain.

All inquiries to be addressed to B. SINGER, Steger Building, Chicago, Illinois. 71 H

THE PROPRIETOR of BRITISH PATENT No. 125,810, dated September 24, 1918, relating to "Improvements in Shearing Machines," is DESIROUS of ENTERING into ARRANGEMENTS by way of a LICENCE or otherwise on reasonable terms for the purpose of EXPLOITING the above Patent and ensuring its practical working in Great Britain.—All inquiries to be addressed to B. SINGER, Steger Building, Chicago, Illinois. 58 H

THE OWNER of PATENT No. 20,046 of 1911, for "Improvements in and relating to Metal Sheet Piling," DESIRES to LICENSE or SELL the PATENT RIGHTS in Great Britain.—Address, E. P. ALEXANDER and SON, Chartered Patent Agents, 366, High Holborn, London, W.C. 1. 59 H

For continuation of Small Advertisements see page 3.

The Stability of the Sailing Warship

No. V.*

By A. W. JOHNS, C.B.E., R.C.N.C., M.I.N.A.

In a paper read before the Institution of Naval Architects in 1860 the late Mr. F. K. Barnes described an inclining experiment carried out on the Perseverance in 1855. This vessel had capsized in dock, and it was found necessary to determine her stability by an inclining experiment. The angle of heel gven her was $3^1/_{12}$ deg., and the method of Atwood was employed to find the position of the centre of gravity. As a matter of curiosity Mr. Barnes, after completing the calculations, determined the point at which the line of action of the buoyancy at $3^1/_{12}$ deg. intersected the middle line plane, and found this point to be ¼in. from the calculated position of the metacentre. The distance between the latter and the centre of buoyancy was 114in., so that the error was 1 in 912. When the approximate nature of the calculations employed, and also the fact that small errors in the experiment itself affect the results, the close agreement is remarkable. It was thereupon concluded that the metacentric method of considering stability was sufficiently accurate for practical purposes up to 3 deg. or 4 deg. of heel. This result was arrived at in 1855, nearly 110 years after the publication of Bouguer's book and fifty after that of Admiral Chapman's. Later experience showed that the limiting angle of heel at which the metacentric method applied was 9 to 10 deg., and it has so been used for determining initial stability, the methods of Atwood being confined to the larger angles of heel necessary for determining curves of statical stability. Sir Edward Reed states that such curves were drawn by French naval constructors in 1863 and by their British colleagues in 1867–8 in connection with the stability of low freeboard monitors.

In the paper referred to, Mr. Barnes stated that no inclining experiments had been carried out on British warships between that on the Rover in 1832 and 1855, when the Perseverance was inclined. This interval of time had, however, been of the greatest interest from the point of view of the stability of British warships.

The position of Surveyor of the Navy was established by Henry VIII. in 1545, the first holder being Captain W. Broke. Up to 1667 the post had generally been held by a naval officer, but in that year Colonel Thomas Middleton was appointed. In 1672 he was succeeded by Sir John Tippetts, who had been Master Shipwright from 1650 to 1667 and Naval Commissioner from 1667 to 1672 at Portsmouth. From 1672 to 1832 the position was held sometimes by one and at other times by two officers who had previously been Master Shipwrights. In 1832 Sir Robert Seppings occupied the post. He had effected many improvements in warships, including the introduction of round sterns, by which the number of chase guns mounted was appreciably increased; diagonal framing which improved the strength; and the present method of building docking blocks. He was, however, retired and succeeded by Captain Symonds, a naval officer, who was in turn succeeded by Captain Sir Baldwin Walker. In 1855 the latter was appointed Controller, the Surveyorship was abolished, and Mr. Isaac Watts made Chief Constructor of the Navy. He was succeeded in 1860 by Mr.—afterwards Sir Edward—Reed.

Captain Symonds, whilst at Malta in 1821, designed and built a yacht, the Nancy Dawson, which proved to be extremely fast, outsailing yachts of a much larger size. Her success led her designer to believe he had hit upon a new secret in naval architecture. Four or five smaller yachts on similar lines were built by him, and these "answered beyond my warmest expectations and confirmed the success of my principles. Great breadth of beam and extraordinary sharpness are the characteristic features of my system."

Symonds possessed no theoretical knowledge on the subject of ship stability and, judging from the remarks of his biographer, was inclined to ridicule such knowledge. In reporting on a visit to Brest he stated that some of the French engineers who accompanied him agreed with him that their new ships were very inferior in form and qualities to their older ones. They appeared ashamed of them and all agreed "Theory had ruined all their experiments." Symonds carried to extremes the principle enunciated by Pepys and others that "breadth only will make a stiff ship." In increasing the beam far beyond that usual he had to modify the shape of the 'midship section. The rounded bilge was straightened, the rise of floor considerably increased, and the area omitted at the bilges was added in the vicinity of the water plane. The 'midship section thus became of peg-top form and has since been known as the Symondite type of section—see the engraving given below.

Symonds returned to England in 1824, his reputation as a yacht designer having preceded him. Convinced that the features embodied in his yachts would improve the qualities of warships, he pressed Lord Melbourne, the First Lord of the Admiralty, to allow him to design a warship. After some hesitation permission was given him, with the result that the Columbine, a 12-gun brig, was designed by him, built at Portsmouth Yard and completed in 1826.

In 1810 the first School of Naval Architecture was established at Portsmouth, on the recommendation of Lord Barham's Commission, which inquired into the civil affairs of the Navy. The principal of the School was Dr. Inman, a distinguished mathematician, who translated Chapman's book on "Ship Design" for the benefit of his students. The latter were thus instructed in the most up-to-date methods of design. As a test of these methods the School was ordered in 1821 to design and build a 16-gun vessel named the Rose. When completed and tried, although she was found to possess no phenomenal qualities, she proved a steady and handy vessel, working easily under sail. The naval authorities were satisfied with the results, and other ships were ordered to be built and to be on generally similar lines.

At about the same time a naval officer—Captain Hayes—brought forward what he considered to be an improved form for warships. He was allowed to embody this in a cutter named the Arrow, which proved superior to the cutter Basilisk designed by Seppings. In 1824–5 three 18-gun corvettes were tested. These were the Champion, designed by Hayes; the Pylades, by Seppings; and the Orestes, by Dr. Inman's pupils. At first the Champion proved superior, but after alterations had been carried out in the other two as a result of experience obtained, the Orestes was awarded the first place, with the Champion third.

A further series of experimental trials was carried out in 1827, in which four vessels competed. One was the Columbine of Symonds, the others were 28-gun corvettes, the Tyne of Seppings, the Challenger of Hayes, and the Sapphire of the School of Naval Architecture. According to Symonds, his vessel proved greatly superior to the others, but the official report shows that, although she was superior in moderate weather, in a strong wind the Sapphire sailed best on all points. Modifications were carried out on the ships and a second series of tests were made. The Columbine was still superior in moderate weather, but the Sapphire was not so satisfactory in a strong wind as before. A third series with the ships at deep draught showed the Columbine superior in moderate, but she failed in heavy weather. There was little to choose between the other three.

The success of the Columbine in these trials and the growing reputation of Symonds as a designer led the responsible naval authorities in 1831 to order him to design and build a 50-gun frigate named the Vernon. The following year before she was completed, Seppings was retired, Symonds took his place, and the School of Naval Architecture was closed. Sir James Graham was the First Lord of the Admiralty at the time.

The last list of standardised dimensions of British warships had been promulgated in 1745, and although no other had been suggested, there appears to have been a tacit understanding that no violent departures from the dimensions and tonnages of 1745 would be permitted. Successive Surveyors had protested against the limitation, pointing out that it prevented all progress. These protests were of no avail. With the advent of Symonds as Surveyor all limitations on dimensions and tonnages were removed and he was given a free hand.

Symonds continued as Surveyor until 1848, and during the sixteen years he was in office designed a large number of warships. The majority of these were sailing ships, but a number of steamships were also built, the first in 1833. Towards the end of his occupancy of the office iron ships were also built, the first of these being in 1846. All Symonds' ships possessed the characteristics of great beam and extraordinary sharpness.

The main differences between Symonds' ships and those of necessarily older ships can be seen from the following table:—

Name of ship.	Number of guns.	Designer.	Length on gun deck.	Beam.	Depth of hold.	Tonnage.
Queen	110	Symonds	204	60	23½	3099
Caledonia ..	120	Rule	205	53½	23½	2747
Vanguard ..	80	Symonds	190	56½	23½	2589
Canopus ..	80	Rule	194	51½	23½	2257
Boscawen ..	70	Symonds	180	54	22½	2212
Spencer ..	74	Barallier	181	49½	21½	1917
Pique	36	Symonds	160	48½	14½	1622
Pomone ..	38	Captd. French	159	42	12½	1239
Vestal	26	Symonds	130	40	10½	913
Sapphire ..	28	S. of N.A.	119	33½	8	605
Columbine ..	16	Symonds	105	33½	8	492
Pylades ..	18	Seppings	109	30	—	—

It will be seen that in the larger classes the beam of Symonds' ship is about 5ft. greater than that adopted by other designers. This increase would result in the metacentric height being approximately 2½ft. more. The amount of ballast carried was less, the Vanguard at first carrying 140 tons, afterwards reduced to 70 tons, as compared with 300 tons usually carried by ships of the same rate.

Experimental cruises to test the ships of Captain Symonds' design with those of others continued from 1835 to 1844. Generally the results of these tests showed that the Symondite ships possessed far more stability than the others and were better sailers in moderate weather. At times, however, heavy rolling and pitching were reported, as in 1835, when the Barham, built 1811, Revenge, 1805, and Vernon were in the same squadron, and it was reported that the Vernon "pitched very deep and more so than any ship-of-war we have sailed in, and when pressed with sail in a heavy sea so much so as to endanger the bowsprit and masts."

Similar complaints as to quick and violent rolling of the type were received, and gradually it became evident that Symonds, by considerably increasing one quality, had sacrificed others which were of almost equal importance. Our theoretical knowledge on the stability and rolling of ships has since confirmed this view, but at the time it was not available, and the result had to be obtained by actual and costly experience. Captain—then Sir William—Symonds was retired in 1848, and an extremely interesting chapter in the history of the stability of the sailing warship was brought to a close. In the same year the second School of Naval Architecture was opened, an indication that perhaps after all theoretical knowledge might prove of some use in the design of warships.

Seven years later the responsibility for the stability of warships was placed in the hands of those who by training and experience were best qualified to hold it. Only once afterwards was this responsibility placed elsewhere, and with unfortunate results. This was in the case of the Captain, a masted low-freeboard turret ship, which in 1870 capsized whilst under sail. She was built against the advice of the Admiralty constructive staff.

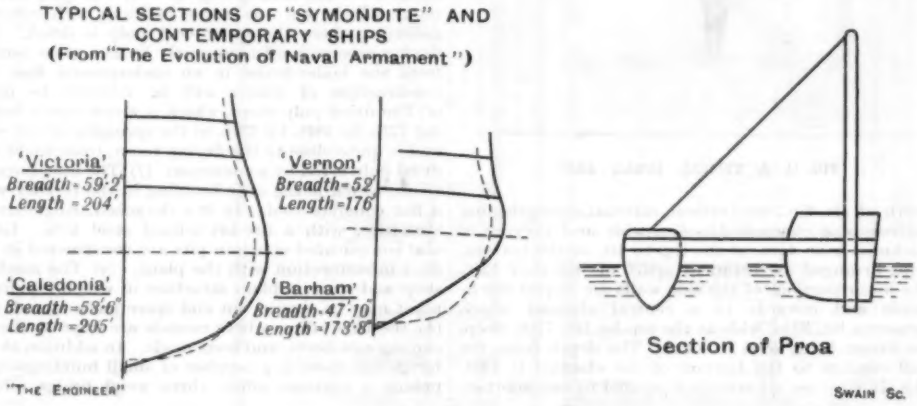
Since 1833 steam had gradually been coming into use for the propulsion of warships, and this alteration rendered the problem of ships' stability a much easier one. It removed the heeling effect of the pressure of wind on the sails and transferred the weight of the instruments of propulsion, the masts, spars, rigging, and sails, from a relatively high position to that of the machinery, boilers, water, and coal, a relatively low one. The sailing warship and its problem of stability were passing away.

In 1860 the Institution of Naval Architects was founded, and from that time onward the subject of ship stability has received the attention it deserves. The papers read at that Institution and the discussions which have resulted therefrom have fully elucidated the principles underlying the subject.

Before concluding this account it is interesting to notice how primitive man, guided by centuries of experience, has solved the problem of the stability of the sailing vessel. Probably the best example is that of the Flying Proa of the Ladrone Islands, although similar constructions are met with in other uncivilised parts.

The flying proa is a boat about 40ft. in length, symmetrical about amidships, so that either end may be bow or stern. Unlike ordinary boats, it is not symmetrical about the longitudinal vertical plane through the keel. One side of the boat is shaped as ordinary boats, but the other side is flat and vertical and a short distance from the vertical plane through the keel. Projecting from the ordinary side of the boat are three stout outriggers well secured to the

TYPICAL SECTIONS OF "SYMONDITE" AND CONTEMPORARY SHIPS
(From "The Evolution of Naval Armament")



* No. IV. appeared August 18th.

hull and well braced together. They support at their outer ends a smaller boat, symmetrical about amidships and about its middle line plane. This smaller boat is 16ft. long and is 11ft. from the keel line of the larger boat and parallel with it. A mast is fitted at the middle of the length of the larger boat and carries a lug sail fitted with gaff and boom. The mast is well stayed to the outrigger spars. The ordinary side of the boat, *i.e.*, that on which the outriggers are fitted, is always the windward side, the sail being turned end for end as necessary to ensure this result. No rudder is fitted, steering being carried out by a paddle over the after end. The weight of the smaller boat prevents any heeling, and if the wind is very strong one or more of the crew lies out along the outriggers. Very little leeway is made with the wind abeam, since the flat leeward side prevents it. The crew consists usually of six natives, one at either end and four amidships, to look after the sail or, if necessary, to sit on the outriggers. Experience has taught the native builders how to secure the best results, and it is stated that twenty miles an hour is no uncommon speed. A boat of this type was constructed and tried at Portsmouth early in the last century, and report states that the speed attained was extraordinary. A sketch of a Proa is given on page 183.

The method of securing stability limits the size possible for this type of craft, but it remains a practical illustration of the dictum of Pepys and others that "only breadth will make a stiff ship."

The Kelham Beet Sugar Factory.

No. II.*

The Beet Silos.

The Kelham sugar factory has been designed to deal, when in full operation, with 600 tons of beet per day of twenty-four hours during a "campaign" of 100 days' duration. Unless something untoward takes place a sugar factory does not stop running while the "campaign" lasts, but continues to work day and night; in fact, one enforced stoppage of the machinery may mean the loss of the entire profit of a campaign. In the course of its "campaign," the Kelham factory, when in full operation, is expected to deal with some 60,000 tons of beet, and to produce therefrom 8000 tons of sugar, in addition to certain by-products which will be referred to later. The proportion of 8000 tons to 60,000 represents a percentage yield of 13.3 per cent. of sugar, which may be regarded as high. The beet sugar "campaign," it may be explained in passing, starts about the end of September, and continues to the end of December or beginning of January. During the "campaign" recently concluded, the Kelham factory dealt, as has been said, with some 25,000 tons of beet, which had been specially grown for it by a total of 425 farmers. It was felt that that was as large a quantity as it would be safe to undertake in the first instance, until the machinery had been adequately tested and the British workmen, up till now totally unacquainted with the work, had been thoroughly trained. Some of the beet reached the factory by barge, much came by rail, and some, from the immediately surrounding districts, came by road. As a matter of interest we give an illustration of a sugar beetroot in Fig. 11.

FIG. 11—A TYPICAL SUGAR BEET

It is necessary, as has been already pointed out, to have in a beet sugar factory a considerable amount of storage capacity for the roots. An ideal arrangement, of course, would be to have the beet coming in at precisely the rate at which it is being dealt with; but that is impossible, so storage is provided. Manufacture must follow fairly closely on the heels of delivery, for otherwise the roots begin to shoot, which means that they are feeding on their own sugar, and the return in finished product is not as high as it might have been. At Kelham there are six silos for storage purposes—see the drawing Fig. 12 and the two views Figs. 17 and 18, page 187. Each of them is 328ft. long and 20ft. wide. They are constructed of reinforced concrete. The upper portions of their side walls, to a depth of 5ft. 2in., are vertical, internal strengthening buttresses of concrete 1ft. 6in. wide and varying in thickness from 4½in. at the top to 1ft. at the bottom, being arranged at distances apart of just over 12ft. The lower portions of the side walls are sloped downwards and inwards to a central channel which measures 1ft. 3¾in. wide at the top by 1ft. 7¾in. deep, the invert being oval in form. The depth from the wall copings to the bottom of the channel is 14ft. The six silos are all arranged parallel to one another, and between the first and second, third and fourth, fifth and sixth, there is a line of railway so that the railway trucks carrying the beet can be run alongside, and their contents be discharged into any silo with the least possible expenditure of labour. Alongside the outer sides of silos Nos. 1 and 6, and between silos 2 and 3, 4 and 5 there are cartways so that vehicles bringing their loads by road can also similarly be discharged. The silos have a combined capacity of 312,000 cubic feet, which is sufficient, so we understand, to store 5000 tons of beet, that is to say, enough to keep the factory fully supplied for something over eight days. A characteristic of the sugar beet is that its specific gravity is nearly the same as that of water, so that it is quite easily conveyed from place to place by a stream of that liquid.

Arrangements have been made by which water can flow along the channels at the bottoms of the silos, and the beet, sliding by gravity into the channels, is led into an underground flume which is egg-shaped in cross section with a major axis of 2ft. 3⅞in. and a minor axis of 1ft. 4½in., and which runs right into the factory. The tops of the channels are ordinarily covered with a wooden grating, so that the beet, when shot into the silos, do not fall into and choke the channels. The gratings are, of course, removed as and when the silos are being emptied of their contents.

The Factory Buildings.

The factory buildings, exterior views of which are given in Figs. 15 and 16, page 187, consist of the following:—(*a*) The main machinery hall, which contains all the plant for manufacturing the sugar, and is 280ft. long by a varying width of 48ft. to 70ft. by 53ft. high to apex of the roof. There is a complicated arrangement of floors and galleries at different heights to give access to the various portions of the machinery. The ground floor, which is of concrete, is level throughout. In it, however, are numerous pits varying in depth from a few inches to 21ft. The galleries are constructed of steel beams on cast iron columns. The major portion of these galleries is covered with 2in. thick planking, grooved and oak-tongued. Where water from the process had to be contended with, however, the galleries are of asphalt on concrete, graded and drained. (*b*) The sugar store, which adjoins the main machinery hall and is 73ft. by 72ft. by 20ft. high to the springing of the roof. The floor is raised to tailboard level above the adjacent road, and there is a loading platform protected by a wide cantilever roof along one side of the building from which the sugar can be loaded into lorries or railway wagons. (*c*) The boiler-house, which measures 84ft. by 57ft. by 24ft. to the roof springing. (*d*) The pulp-drying room, which is a one-storey building with concrete galleries, where the spent beet pulp is dried. The drying process is effected partly by hot gases coming from the boiler-house in an underground flue, the construction of which will be referred to later. (*e*) The dried pulp store, which is a one-storey building 72ft. by 48ft. by 23ft. to the springing of the roof, and is quite close to the drying room, from which the dried pulp is fed by a conveyor. (*f*) The lime-burning room, which is the only building in the factory with a flat concrete roof. It is a detached, single-storey structure, with a fire-brick-lined steel kiln. Large and complicated concrete pits are constructed in the floor in connection with the plant. (*g*) The machine shop and store, a plain structure in which repairs to plant may be carried out and spare parts stored, and (*h*) the tare office, where records are kept of the incoming raw beets, and tests made. In addition to the foregoing, there is a number of small buildings comprising a customs office, three weigh-bridge offices, coke and locomotive sheds, and various timber huts for storage and sundry purposes.

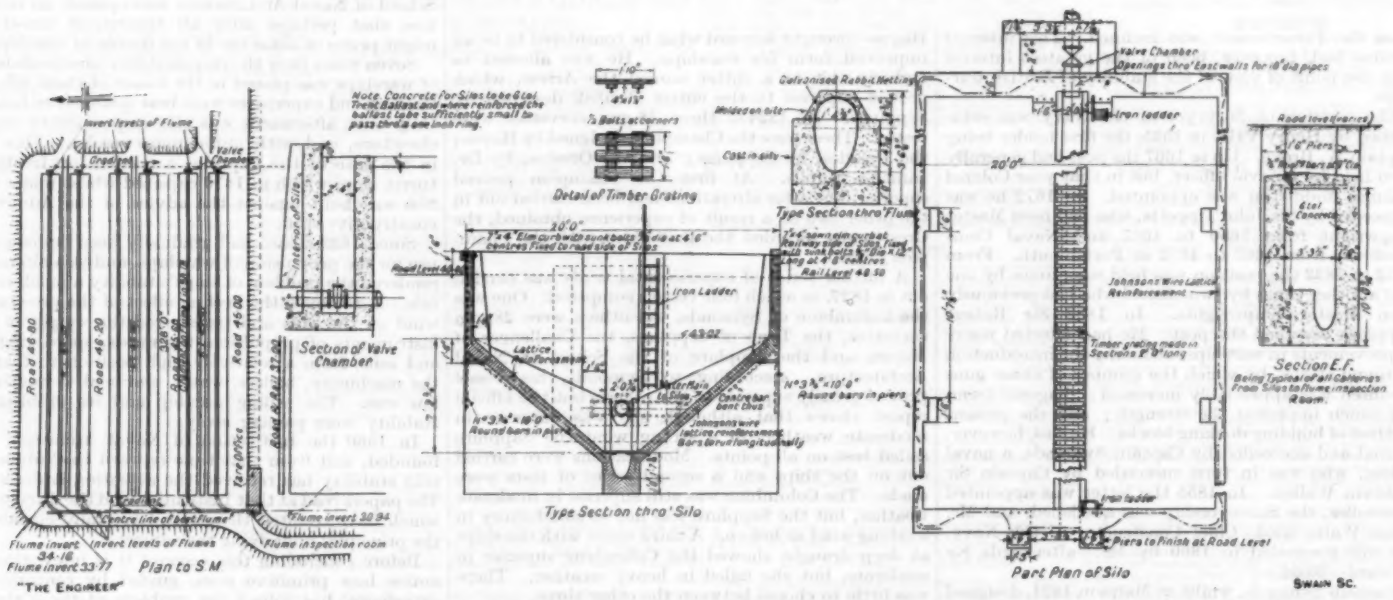

Invert levels of Flume
Grade rail
Valve Chamber
Road 46.80
Road 46.80
Road 45.00
Road 45.00
Tare Office
Road & Rail 37.00
Centre line of beet Flume
Flume invert 34.16
Flume invert 33.77
Plan to S M
Flume invert 30.94
Flume inspection room
Section of Valve Chamber
Note. Concrete for Silos to be 6 to 1 mix. Ballast and where reinforced the ballast to be sufficiently small to pass thro' a one inch ring
Detail of Timber Grating
Type Section thro' Silo
Iron Ladder
Lattice Reinforcement
Round bars in piers
Galvanised Rabbit Netting
Type Section thro' Flume
Cast in situ
Iron ladder
Road level (varies)
Johnsons Wire Lattice Reinforcement
Timber grating made in Sections 5'0" long
Section E.F.
Being Typical of all Galleries from Silos to flume inspection Room.
Piers to finish at Road Level
Part Plan of Silo
"THE ENGINEER"
SWAIN SC.

FIG. 12 PLANS, SECTION AND DETAILS OF RE-INFORCED CONCRETE BEET SILOS

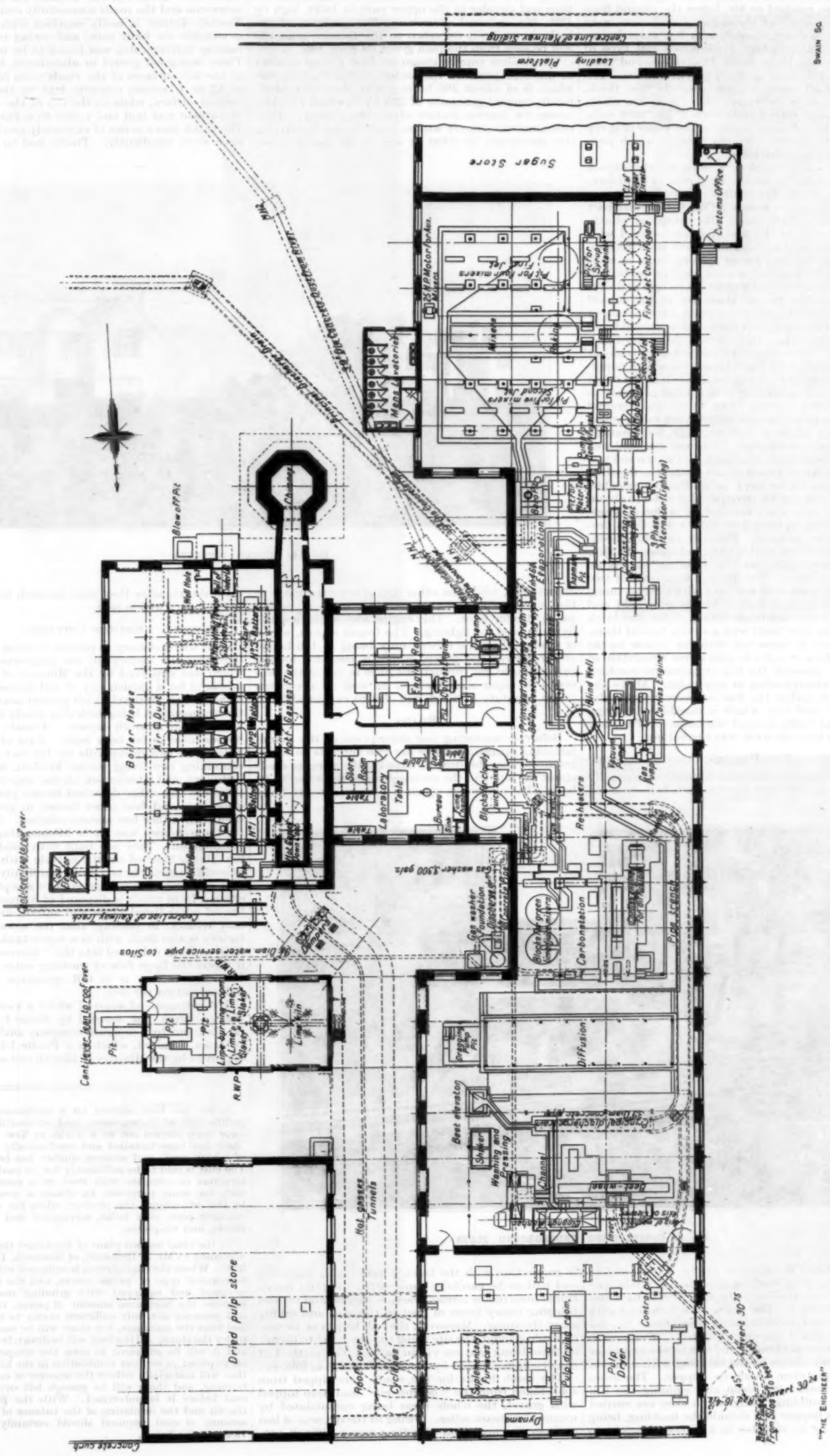
In most cases the concrete used in constructional work was in the proportion of 6 to 1, the gravel employed being all obtained on the site from the borrow pit. Nottingham stocks were used for all brickwork below ground, and Flettons for the remainder. Three-to-one cement mortar was used throughout—excepting for the chimney stack—the sand being obtained on the site. Generally speaking, the class of construction

* No. I. appeared August 18th.

PLAN OF THE KELHAM BEET SUGAR FACTORY

HAL WILLIAMS AND COMPANY, LONDON, ENGINEERS

(For description see opposite page)



was the same for all buildings. The foundations were of concrete taken down to firm sand or gravel, which was, as a rule, reached at 8ft. below the ground floor level. The majority of the engine foundations were similarly taken down, though in a few cases it was more economical to adopt a reinforced raft type of construction, the slabs being 18in. thick and reinforced with ¼in. bars or with patent lattice. The floor slab in all cases is plain concrete 6in. thick, excepting in the sugar store, where it is 9in. thick, and is reinforced with double rows of ¼in. steel rods. The finish is 1in. of grano, except where sugar or syrup might come in contact with the floor, in which positions asphalt was substituted.

The walls are of brickwork with weather-struck joints and piers at the main load points, so as to form symmetrical panels externally. Special perforated radial chimney blocks were used for the circular part of the chimney shaft above the octagonal plinth. The pitched roofs of the buildings are covered with asbestos tiles on 1in. boarding and steel trusses. There are lanterns with geared opening lights on most roofs, and they, together with a high proportion of glass in the walls, make all interiors very light and airy. The saturated and porous character of the subsoil necessitated special and very careful construction of the numerous pits and other works below ground level, to make certain that they should be water-tight. Where such works were not subject to heat this object was attained either by constructing them with super-cement concrete, or by double walls with medusa and cement between, according to the head of water to be resisted. But in such cases as the underground flues from the boilers to the pulp-drying room, which have to carry gases at a fairly high temperature, special designs were adopted. The cross-sectional area required for these flues was large, and as the soil was difficult to excavate owing to the water, the depth of excavation had to be kept as shallow as possible, which meant that the width required in order to obtain the necessary area was excessive for a flue of single span. Accordingly, twin flues with a 9in. thick fire-brick lining were adopted. The design employed consists of an outer brick shell in two thicknesses of 13½in. and 9in. respectively, with a medusa waterproof lining between them. The floor is composed of two thicknesses of reinforced concrete with medusa lining between, and upon it hollow blocks were laid and covered with the fire-brick lining. The fire-brick sides of the flue were built with a cavity behind them, and this cavity is connected with the hollow blocks beneath the floor in order to give a free circulation of air, and thus prevent the flue temperature reaching the medusa waterproofing at any point. Above the twin fire-brick arches the flue is covered with a flat concrete and steel top, which is capable of bearing the usual road traffic around the factory. The view Fig. 13 shows how the work was carried out.

The Boilers.

The boiler-house was designed to contain eventually three batteries of Stirling boilers, each battery rated to produce 20,000 lb. of steam per hour from and at 212 deg. Fah., at a working pressure of 170 lb. per square inch. At present only two of the batteries have been installed. The boilers are furnished with chain grates and mechanical stokers made by the Underfeed Stoker Company, Limited. The coal is taken up to overhead bunkers by means of an elevator arranged at one corner of the building with a line of railway running close beside its hopper. The ashes drop into a tunnel 9ft. deep and running the full length of the building, along which they are carried in trucks to a hopper just outside the building, being lifted thence by an elevator to a sufficient height to permit them to be delivered into carts to be taken away. The chimney shaft, which is octagonal at the base and circular in the upper part, is 165ft. high by 12ft. 6in. internal diameter. The position of the boiler-house with reference to the factory generally will be seen from the plan given on page 185.

The boilers supply steam to four Corliss engines in different parts of the factory. The first engine, which is of about 300 horse-power, drives an alternating-current generator of 220 kVA, which provides power for various motors about the factory. Then there are two exactly similar engines, one for driving the machinery in what is known as the diffusion department, while the other drives the machinery in the sugar-making department, to both of which we shall refer later. This engine also works a small dynamo used for lighting. The fourth engine, which is smaller than the others, only being of 180 horse-power, drives the pump, which is used for forcing carbonic acid gas through the juice in one of the processes of sugar manufacture, as well as a vacuum pump, the duty of which will also be explained later.

FIG. 13—CONSTRUCTING UNDERGROUND FLUES

Roads.

Before commencing our description of the manufacturing operations there are two subjects to which attention may be drawn, namely, the various roads about the site and the cottages which have had to be built. The new roads which it was necessary to build in connection with the factory were rather extensive and had to be carefully constructed to stand heavy traffic from motor lorries, traction engines and trailers bringing heavy loads of beet to the silos and taking away the sugar. Moreover, they all had to be formed on made ground, the site being too low-lying to permit of their being laid on virgin earth. The method of construction adopted by the engineers was as follows:—The earth banks for the roads were tipped from spoil taken from the "borrow-pit" and were topped with gravel, the whole mass being consolidated by means of a steam roller. Owing to the dryness of last summer the operation of rolling was a difficult proceeding, as the earth simply banked up in front of the roller. However, the troubles encountered were overcome and the roads successfully completed. The Newark district is badly supplied with stone which is suitable for hard core, and, owing to the cost of railway carriage, slag was found to be too expensive. There was good gravel in abundance, however, and so the sub-surfaces of the roads were formed of 8in. of 12 to 1 cement concrete laid on the top of the formed surface, while on the top of the concrete 4in. of Tarmac was laid and rolled to a finished surface. The result was a series of extremely good roads which have worn excellently. Traffic had to be run over them shortly after they were finished, but they stood the test very well indeed.

FIG. 14—KELHAM COTTAGES

Kelham Cottages.

As it was necessary to provide housing accommodation near the factory for the employees, a scheme, which was approved by the Ministry of Health, was prepared for a garden city of 101 houses to be built on some comparatively high ground near the factory, the arrangement being such that nearly all the houses would have a south aspect. Actually only seven houses have so far been built. First of all, there is a detached two-storey villa for the factory manager, containing two living rooms, kitchen, &c., and four bedrooms and a bathroom on the upper floor. Then there are two other detached houses planned on the same lines and four other houses in groups of two, each with rather less accommodation. The contract for these houses was let to Messrs. Hayes Bros., of Nottingham. They are built with solid brick walls 9in. thick, finished on the outside with a rendering of cement mortar in two coats and finally with rough-cast in lime. The sewage goes to a septic tank, the effluent from which is disposed of by means of a long line of agricultural pipes and subsoil drainage. We may remark, in passing, that the sewage from the factory is also dealt with in a septic tank, the effluent from which is delivered into the "borrow-pit," where it meets the large flow of washing water, amounting, when the factory is in full operation, to some 2½ million gallons per day.

The cottages—of some of which a view is given in Fig. 14—were not erected by Home Grown Sugar, Limited, but by a separate company entitled Kelham Cottages, Limited, which is a Public Utility Society approved by the Ministry of Health and assisted by it.

Work has been started on a mechanically operated puddle mill at Youngstown, and successful experiments have been carried out at a works in New Jersey where plant has been installed and mechanically puddled iron of a high grade and uniform quality has been produced. The cost is said to be sufficiently low to enable the manufacturers to compete with steel on a commercial basis and, for some purposes, to obtain a premium, owing to the advantages the product offers for such work as wrought pipe, stay bolts, corrugated and plain roofing sheets, and tin-plates.

In the ideal cement plant of the future there should be, according to Mr. J. Brobston, of Nazareth, Pa., no wasted heat. Where the engine-room is equipped with the modern economical type of prime mover, and the mill has been designed and equipped with grinding machinery that requires the minimum amount of power, the flue gases will generate not only sufficient steam to run the plant and heat the buildings, but there will be enough left over to dry the stone. All the heat will be drawn from the clinker and it will be sufficient to raise the temperature of the air required to support combustion in the kilns to a point that will materially reduce the amount of coal needed for burning, and there will be enough left over to dry the coal before it is pulverised. With the pre-heating of the air and the insulating of the balance of the kiln, the amount of coal required should certainly not be over 75 lb. to the barrel.

THE KELHAM BEET SUGAR FACTORY

HAL WILLIAMS AND COMPANY, LONDON, ENGINEERS

(*For description see page* 184)

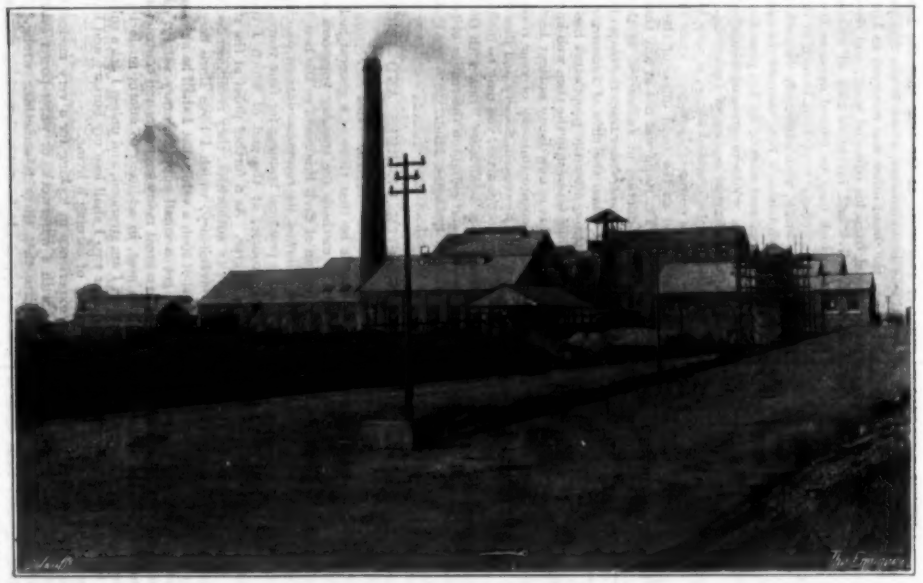


FIG. 15—THE FACTORY LOOKING SOUTH-WEST

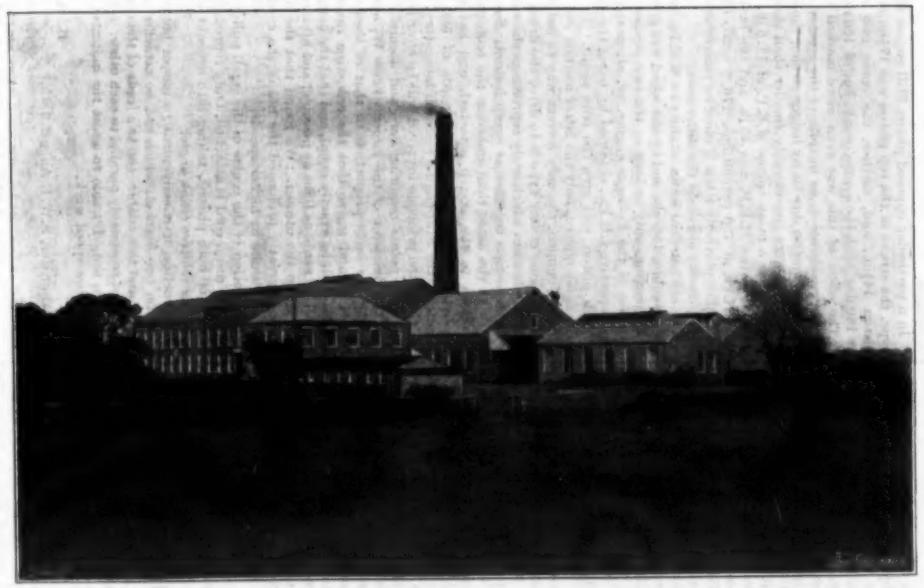


FIG. 16—THE FACTORY LOOKING NORTH-EAST

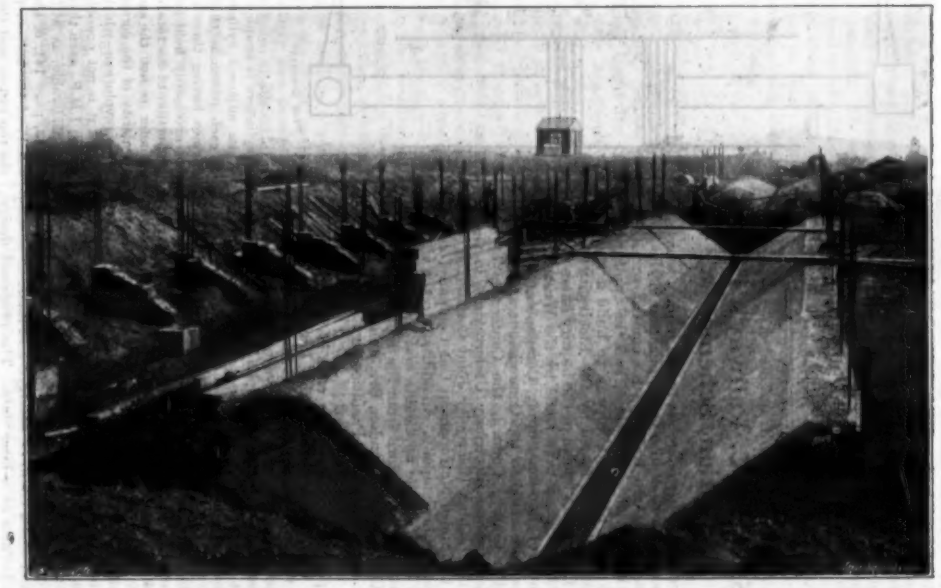


FIG. 17—VIEW OF THE BEET SILOS DURING CONSTRUCTION

FIG. 18—THE COMPLETED BEET SILOS

South African Electricity Bill.

The Electricity Bill passed by the South African Parliament provides for the establishment of an Electricity Supply Commission, the functions of which will include the establishment, acquisition, maintenance and working of undertakings for an efficient supply of electricity to Government Departments, the South African Railways and Harbours Administration, local authorities, companies, and others; the investigation of new or additional facilities for the supply of electricity and for the co-ordination and co-operation of existing undertakings, so as to stimulate the provision of a cheap and abundant supply of electricity. The Commission will be given powers to raise money by way of loan, to acquire land and water rights, machinery, plant, transmission and distribution lines, &c. It will also be empowered to enter into contracts for the supply of electricity.

The following clause sets forth the duties of the Commission:—The Commission shall, as soon as possible after its establishment, proceed to investigate the question of establishing or acquiring electrical undertakings in the Union, and if it is of opinion that any undertaking should be established or acquired by it at any place, it shall apply to the Board for a licence or permit therefore. . . . It shall also submit its report and proposals to the Minister. If the Board grants the licence or permit, and if the Minister approves the proposed scheme, the Governor-General may authorise the Commission to raise by way of loan . . . the capital money necessary for financing the undertaking.

It is also provided that at the expiration of five years after the Commission has commenced the supply of electricity from an undertaking, or if the Minister at any time after the expiration of this period informs the Commission that the undertaking might be more advantageously worked by another undertaking, the Commission shall invite tenders for the acquisition or working of that undertaking.

The section of the Bill providing for the establishment of the Control Board referred to in the clause quoted above says:—For the purposes of controlling the supply of electricity by the Commission or by any private undertaking the Minister shall designate not less than three or more than five persons . . . to be a Board called the Electricity Control Board. . . . From and after the commencement of this Act or, in the case of undertakings existing at such commencement, after the expiry of twelve months therefrom, neither the Commission, nor any person, company or association of persons shall carry on or engage in any manner in any undertaking for the supply of electricity to other persons except under the authority of a licence or permit issued under this chapter.

No such licence, however, will be necessary to authorise a supply of electricity by a Government Department or the South African Railways and Harbours Administration, except in certain cases, by an urban local authority, by any undertaking when the rated capacity of its electricity supply plant is less than 500 kilowatts, or by any person exempted under certain conditions set forth in the Bill.

Amongst the detailed regulations contained in the remaining clauses of the Bill is the following:—After the expiry of twelve months from the commencement of this Act, any person erecting any machinery for the generation of electricity shall erect it in accordance with the regulations in respect of frequency, type of current or pressure, unless it is for the owner's own use and its rated capacity does not exceed 500 kilowatts, or unless it is specially exempted by the Board.

The S.E. and C. Railway's Electrification Scheme.

A statement with reference to the inquiry which was held a short time back into the application of the South-Eastern and Chatham Railways for consent to establish a generating station at Charlton, and the application of the West Kent Electric Company to build a station at Erith, has just been issued by the Electricity Commissioners. During the course of the inquiry offers to supply the railway company were made by the West Kent and the County of London Supply Companies, and representations were made to the Commissioners on behalf of the London County Council, the Conference of Local Authorities owning Electricity Undertakings in Greater London, the London Electricity Joint Committee (1920), Limited, the South Metropolitan Gas Company, and the British Petroleum Company. In addition to the witnesses called on behalf of the applicants and the County Company, witnesses were heard from the London and South-Western Company, the London, Brighton and South Coast Company, and the Trade Facilities Act Advisory Committee.

An important factor in the case is the forthcoming grouping into one system of the London and South-Western, the London, Brighton and South Coast, and the South-Eastern and Chatham Railways. The London and South-Western Company is supplied from its 25-cycle station at Wimbledon, whilst the London, Brighton and South Coast Company purchases energy from the London Electric Supply Company's 25-cycle station at Deptford. The further electrification of the latter company's suburban lines will entail a supply which will be many times greater than that now given by the London Electric Supply Corporation, and as the equipment of the company's rolling stock is designed for 25-cycle current, the supply must be given at that frequency. The South-Eastern and Chatham Company also desires a 25-cycle supply, but a 50-cycle supply is also practicable. The latter company's proposal is to construct a 60,000-kilowatt station which could be enlarged and made to develop 150,000 kilowatts at a later date. The proposed design, as shown by the plans submitted, is, in the opinion of the Commissioners, impracticable for a station with an ultimate capacity of 150,000 kilowatts, and the principal witnesses on behalf of the railway company agreed that a complete modification of the design would have to be made. Before giving their consent to the construction of this station, the Commissioners would in any case call for the production of more adequate plans.

The railway company expects to complete the first stage of its electrification scheme by June 30th, 1925, and arrangements have been made with the Treasury for a guaranteed loan of 6½ millions, and 5 millions are to be expended on the electrified lines. The financial assistance is dependent upon the scheme being begun forthwith. During the course of the inquiry, carefully prepared estimates were submitted to the Commissioners by the railway company, by the West Kent Company, and by the County Company, the estimates dealing with the cost of supplying the present and prospective demands of the South-Eastern and Chatham Railway and the London, Brighton and South Coast Railway, and after making certain adjustments in these estimates the Commissioners concluded that it had been proved that there are authorised undertakers willing to give the railway company an adequate supply of electricity to meet its present and prospective demands, and at a cost which would not exceed that incurred if the company generated its own current.

The evidence of the railway company at the inquiry was to the effect that the management was prepared to consider taking a supply from an outside source, subject to satisfactory guarantees as to cost, reliability of supply and time of delivery, and the Commissioners are strongly of opinion that the company ought to carry this matter further by entering into immediate negotiations with the authorised undertakers and discussing the terms of a firm contract, including a guarantee to indemnify the railway company in the event of the authorised undertaker failing to give the supply by the required time. Whilst the Commissioners fully realise the urgency of the matter from the point of view of the early commencement of the electrification scheme, they are of opinion that, having regard to the important interests involved, the parties should be given a further opportunity of conferring together in order to arrange a mutually acceptable contract, and they have therefore postponed their decision to enable this to be done.

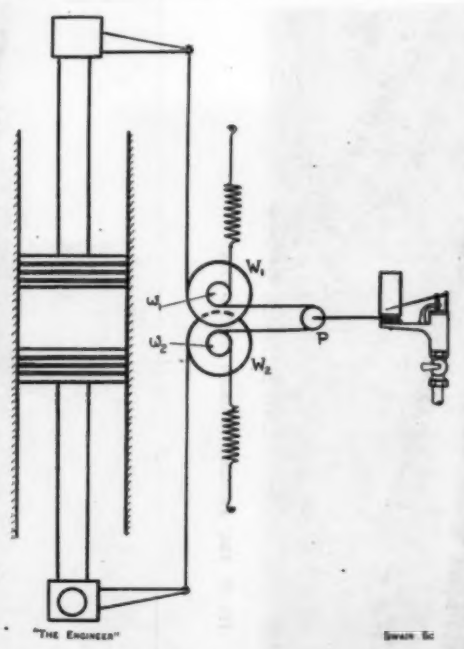
Letters to the Editor.

(We do not hold ourselves responsible for the opinions of our correspondents.)

INDICATING OPPOSED PISTON ENGINES.

Sir,—In studying the article in your issue of August 11th, "Tests of a Cammellaird-Fullagar Marine Diesel Engine," which I did with great interest, I noticed that in taking the indicator diagrams—each set of which consisted of fifteen cards—although they were taken as nearly as possible at the same instant, the diagrams for the top and bottom pistons were taken separately. Your readers may be interested if I shortly point out the inaccuracies which may arise when indicating an opposed-piston engine in this manner, and describe a very simple method of indicating, in which the motions of both upper and lower pistons are taken into account.

In the case of the Fullagar engine, the top piston of each pair



of cylinders is coupled to the crosshead of the bottom piston of its adjacent cylinder, and the stroke and swept volume of each piston is therefore equal. In other opposed-piston engines having three cranks per cylinder this condition does not necessarily hold good. In either case, at any instant the proportion of its total stroke traversed by each piston in any cylinder is not the same, owing to the different phase and angularity of the corresponding connecting-rod. Even for the same revolution—which using one indicator and two separate drives it is not possible to indicate—the difference in M.E.P. and in I.H.P., even though with equal swept volume and speed, is considerable, as will be seen from the cards reproduced in Fig. 3, page 141, of the article. In this case, the M.E.P. and I.H.P. of the bottom piston are always greater than those of the top piston, and the difference should always be a constant percentage for similar shaped cards. But with the method adopted of indicating the pistons separately, the difference—on the selected cards given—varies between 16.6 and 20 per cent., and is due to the variation in mean M.E.P. at the different times the cards were taken.

In a high-speed engine, the difficulty, and hence the likelihood of error, is very greatly increased, and the results will be more unreliable.

In a particular opposed-piston Still engine of the three-crank type, the stroke of the top piston was 17½in. and of the bottom piston 14½in., and, further, the outer two cranks were not at 180 deg. with the centre crank, but at 165 deg.

The effect of this was even more marked than in the case under consideration, as in spite of the greater swept volume of the upper piston due to its longer stroke, the M.E.P. and even the I.H.P. were considerably smaller than those of the bottom piston. For a mean engine M.E.P. of 72.5 lb. per square inch, the top piston M.E.P. was 46 lb. and the bottom 104 lb., and the I.H.Ps. at 150 revolutions, 176.5 total, 61.5 top and 115 bottom respectively; but it must be remembered that the offset of the cranks increases the differences.

The arithmetical mean of the two M.E.Ps. multiplied by the total combined stroke and by the speed will give the true I.H.P. of the engine, only so long as the two strokes are equal, as in the case of the Fullagar engine, or, alternatively, the sum of the respective I.H.Ps., obtained by using the respective strokes of each piston will give the true result. In the case of the Still engine quoted, only the latter method was correct.

In my opinion, the only correct way to indicate an opposed-piston engine of any type is to drive the drum of the indicator by a mechanism which truly reproduces the sum of the strokes of both pistons together at every instant. Such a mechanism, which at the same time embodies the required reducing gear, is shown in the sketch attached, and has given uniformly excellent results even up to speeds of 500 revolutions per minute at the Still engine research laboratory.

I think the principle involved will be clear from the diagram. The chief points requiring care and accuracy in practice are that the diameter of the larger wheels W_1 and W_2 shall bear exactly the same proportion to that of their respective small wheels w_1 and w_2, so that the reduction ratios from the two strokes shall be exactly equal, and that the compensating pulley P shall be made as light as possible, and all inertia and friction reduced to the utmost. We found that the use of small ball bearings greatly prolonged the life of the cords and conduced to good results at higher speeds.

The motion of the centre of the small pulley P, to which the indicator drum cord is attached, truly reproduces the combined motion of both pistons, taking into account any difference of stroke or relative crank angle.

In practice, it is convenient to mount both sets of reducing gears on one bracket, which can be attached as a unit to the engine, and this enables the two leads of the compensating cord to be kept reasonably parallel to each other. Additional springs, as shown, are advisable to assist the indicator drum spring for all but slow-speed work.

H. A. D. Acland.

Westminster, S.W.1, August 18th.

THE LATE DR. GISBERT KAPP.

Sir,—As a former colleague of the late Dr. Gisbert Kapp, I have read with interest the account which you give of his professional work in your last week's issue. Among the numerous phases of his varied and brilliant career, you mention that he was editor of *Industries*.

May I crave sufficient space in your valued columns to qualify in some degree that statement—if only for the sake of strict accuracy in the history of that now defunct technical journal? To be exact, it should be stated that Dr. Kapp was London editor of *Industries*, at the time that the head office of that journal was in Manchester, where it was first published in 1886. But when the head office was removed to London in 1889, Dr Kapp retired from his editorial work, and devoted his time to the constructive and inventive side of electrical engineering, at a period which may be looked upon as the childhood days of that now extremely important branch of engineering industry, and, as we know, with extremely valuable results.

Mr. James Swinburne, F.R.S., donned the mantle then thrown off by Dr. Kapp, and added, by his pleasant humour, to the gaiety of nations, while progressing electrical engineering as director of the electrical section of *Industries*.

From what has been stated above, it may be noted that Dr. Kapp was London editor of *Industries*, while the present writer was editor-in-chief at the head office of the journal in Manchester, and that Dr. Kapp was not at any time responsible for the shape or production of *Industries*, as that responsibility rested upon the present writer from the issue of the first number in 1886 to 1893, when the title of *Industries* was changed to *Industries and Iron*, after the proprietors had acquired a complete or controlling interest in the then well-known journal *Iron*.

Although all this is now fairly ancient history, still, as you give occasional pleasure to many of your readers by reporting the doings of the Newcomen Society and describing the special features of early locomotives, you may be inclined to view what I have written here as another "link with the past," and give it space to edify and enlighten the reader of to-day.

London, S.W. 1, August 22nd. Geo. Cawley.

UNIVERSITY DEGREES AND ENGINEERING APPOINTMENTS.

Sir,—Can it be that there is a general lack of belief in the value of the methods for training engineers recommended by the Institution of Civil Engineers as the best?

I have followed its recommendations as closely as possible by obtaining practical training for four years, then taking up a University course, at the end of which I took a First-class Honours Degree. As a further proof of the satisfaction I gave the University authorities, they recommended me for an 1851 Exhibition Bursary, which I have since been awarded. This Bursary is of such a value that I shall be able to support myself if I can get a small supplementary salary. But alas! after writing to a great many engineers and contractors, and advertising for a post, in addition to efforts made by my University Professor, I am stranded, and unless I get a suitable post within a month or two I shall lose my bursary and have to find some other way of earning a living.

My experience in looking for a very modest sort of job connected with a waterworks or water power scheme would seem to indicate that there is something wrong. The University graduate appears to be met with nothing more than an amused tolerance on every hand. Times are not normal, of course, but why this prejudice against graduates who are only too anxious to prove themselves worthy?

August 22nd. B.Sc.

A Seven-Day Journal.

Coal Loading Congestion on the Tyne.

THE serious congestion at the coal ports on the North-East Coast, which at one time threatened to extend southward to Immingham, where increasing pressure was being felt, has now been somewhat relieved by the agreement resulting from the conference which was held at the Ministry of Labour on Friday and Saturday, under the presidency of Mr. T. M'Kerrell, of the Industrial Relations Department of the Ministry. At the meeting both the shipowners and colliery proprietors and the transport and railway workers were represented, and after prolonged negotiations a settlement was reached. It has now been agreed that in order to cope with the congestion trimmers and teamers shall work two hours a day overtime on the second shift—from Monday to Friday inclusive—at an agreed rate additional to their ordinary earnings and for an experimental period up to October 31st. If at the expiration of this period it be shown that a third shift is necessary, the parties are again to meet in conference in order to determine this point, and, failing agreement, the matter will be referred to arbitration. In the discussion on the general position attention was called to the tendency to employ larger coal-carrying vessels, which means that bunkering facilities must be modernised and improved if continuous and rapid loading is to be effected.

All Steel Rolling Stock Design.

THE recent decision of the London Electric Railway Company to place contracts with five of the principal British railway rolling stock manufacturers for a sample passenger coach embodying all the latest improvements and of all-steel construction should stimulate competition in design. We are given to understand that the successful firms which are to undertake this work are the Birmingham Railway Carriage and Wagon Company, Limited; Cammell Laird and Co., Limited, of Nottingham; the Gloucester Railway Carriage and Wagon Company, Limited; Leeds Forge Company, Limited; and the Metropolitan Carriage, Wagon and Finance Company, Limited, of Saltley, Birmingham. The five vehicles are to conform generally to the gauge limitations and overall dimensions of the existing rolling stock of the Tube railways, on which they will eventually be placed in experimental service; but, apart from these reservations, ample scope for originality in design has been allowed. It is to be expected that the new designs will embody various innovations, both as regards economy of operation and maintenance and additional convenience and comfort for the passengers.

Yarrow's Boiler Department to Reopen.

ALTHOUGH Clyde shipbuilding activities show as yet few signs of an early recovery, it is with satisfaction that we learn of the intention of Yarrow and Co. (1922), Limited, to reopen its boiler department at an early date. It will be remembered that nearly nine months ago the firm decided to close down its works with the exception of the experimental department, in view of the economic conditions prevailing in the shipbuilding and engineering industries. The department which is to be reopened will, we understand, be employed on orders for both land and marine boilers, which the firm has been successful in gaining. These orders include a contract for several boilers for the Far East. The experience gained with the water-tube boilers of modified Yarrow design, which are installed on nearly all the large ex-German ocean-going liners, has no doubt aroused interest in the use of the water-tube boiler for marine work. On the other hand, this type of boiler is extensively used in central power stations, and we understand that the large Yarrow boiler installed at the Dunston power station of the Newcastle-on-Tyne Electric Supply Company has achieved very satisfactory results.

The Teletype.

CONSIDERABLE interest was aroused by the recent statement that the United States Navy Department was in possession of a perfected instrument enabling wireless messages spelled out on a typewriter keyboard in an aeroplane to be received by a similar instrument at a ground station, which automatically reproduces the letters by printing them on a narrow ribbon of paper. This ingenious apparatus is known as the teletype, and it consists essentially of a combined keyboard transmitter and a printing unit driven by a small electric motor. The printing unit furnishes a home record of the message sent out by bringing the paper ribbon in contact with the rim of a type-wheel, while it also acts as a receiver when another station is transmitting by translating the electrical signals received into printed characters. With the exception of one pair of electro-magnets its operation is entirely mechanical, and it is driven from the electric motor through a system of gears and a clutch. The keyboard transmitter is simple in construction and comprises the lettered key levers, a set of notched selector bars, a contact mechanism and a clutch through which medium the contact operating mechanism is driven. A five-unit code is employed for signalling, and by varying the position of the selector bars, altering the motor speed, or employing more than one teletype, each machine having a different adjustment, the signal code is practically impossible to intercept and secrecy is ensured. This is a valuable asset for naval, military and commercial work. The application of the teletype to wireless communication, though successful, is a special one, and its main field would serve for land-line telegraphic communications up to distances of 600 to 800 miles. Successful installations have been in commercial operation for some time, both here and in America.

Docking the Berengaria.

ON her last inward-bound voyage the Cunard liner Berengaria reached Southampton twenty-four hours late, the delay being caused by damage sustained to one of its port propellers, a blade of which was broken off through coming in contact with floating wreckage. Prior to the accident a speed of 23½ knots was being maintained, but after the accident a speed of barely 18 knots was achieved. On Monday last the vessel was dry-docked in the Trafalgar Dry Dock at Southampton, the whole operation only taking some twenty-eight minutes. She is the largest ship which has occupied this dock, and with her bows touching the wooden fender at one end of the dock only 7in. remained between her rudder and the caisson at the other end. The propeller having been repaired, it is expected that the vessel will resume her sailings from Southampton on Thursday, the 24th instant.

Tramway Noise.

SPEAKING at a recent meeting of the Manchester Rotary Club, Mr. C. Bentham referred to the detrimental effect of artificial noise on the population of towns and industrial areas, and the efforts of the engineer to produce noiseless machinery. He was of the opinion that much more should be done to eliminate street noises, which had become greatly intensified during the last forty years. Happily, the invention of the rubber and pneumatic tire had made motor traffic more bearable as far as noise was concerned, but he awaited with interest the results of experiments with rubber surfaces which were being made in London. In his opinion, the noisiest vehicle—excepting, perhaps, the traction engine—was the tramcar. Very little attempt had been made to deaden the noise of tramcars, and even in the country some tramcars made such a noise that conversation had to be suspended while they passed. It was probable that tramcars run on rails had reached their zenith in this country, and he did not think any more tramway systems would be put down in this or any other country; but in the meantime something should be done to lessen the noise of these vehicles.

Fire Snow.

DURING the week a new fire-fighting appliance passed successful demonstration tests at the works of the Finniston Engineering Company, Scotstoun, Glasgow, which is the manufacturing agent for the inventor, Mr. John Morris. The new appliance is termed the fire snow extinguisher, and it derives its name from the snowlike liquid which is discharged from the nozzle when the apparatus is in operation. It is claimed that the liquid is highly efficacious in dealing with outbreaks of fire, especially those arising from ignited oils and chemicals, the fire being smothered by the carbonic acid gas which is generated and by the thick white fireproof coating which is formed. A further advantage claimed for fire snow is that it is non-poisonous and may be brushed off when dry. The qualities of the extinguisher were tested on burning petrol, also on a wooden erection, and the demonstration was considered satisfactory. The receptacle contains two liquids and is a plain cylindrical vessel, which, when it is inverted, causes the two solutions to mix, generating gas pressure, which expels a stream of fire snow from the nozzle.

A New Canadian Pacific Liner.

THE Canadian Pacific liner Montclare is the last of three passenger vessels which have been constructed for the Atlantic service of Canadian Pacific Steamships, Limited. The first of these vessels was the Montcalm, built by John Brown and Co., Limited, at Clydebank, which ship took up her service from Liverpool to Canada in January last. The Montclare is the second ship to be built at Clydebank, the third of the three being the Montrose, completed earlier in the year by the Fairfield Shipbuilding and Engineering Company, Limited, at Govan. The Montclare, which left Liverpool on Friday last under the command of Captain Latta, is an important addition to the company's fleet. She has a gross tonnage of about 16,400 tons, with a length of 563ft. and a moulded depth of 70ft. The propelling machinery consists of two sets of Brown-Curtis turbines driving the twin screws through double reduction gearing, and the boilers are equipped for oil burning.

Port of London Improvements.

THE Port of London Authority has just placed an order with the East Ferry Road Engineering Works, of Millwall, for two large floating grain elevators for use at the London Docks. The elevators, which will be of the company's latest design, embodying several new improvements, are to be capable of discharging ships' cargoes at the rate of 110 tons per hour. Each elevator will be built on a steel pontoon some 60ft. in length and so arranged that it may be moved about the docks by tugs as required. The power for driving the elevator machinery will be furnished by an oil engine of the Beardmore two-stroke cycle valveless type developing about 300 horse-power. The grain, after being sucked up from the ship's hold, will be automatically weighed in passing through the elevator, after which it may either be delivered loose into barges or coasting steamers or automatically filled into sacks ready for distribution.

Railway Rates and Statistics.

THE Ministry of Transport has just issued a volume of tables which is supplementary to the list of railway rates and statistics published in May last. An important section of the new volume deals with coal, coke and patent fuel, and separate details are given for home consumption and shipment traffic. It is interesting to note that, whereas the average length of haul for home consumption is 58.58 miles and the average receipts per ton-mile 1.23d., in the case of coal shipped these figures are 22.60 miles and 1.51d. respectively. The statistics given should be of great value to traders, the railway companies, and the rates tribunal in the preparation, criticism, and settlement of the schedules of standard charges which are required, under the provisions of the Railways Act, 1921, to be submitted to the tribunal by the end of the year, unless some later date is allowed.

The New Southampton Floating Dry Dock.

WE learn that tenders have now been invited by the London and South-Western Railway Company for the construction of a new floating dry dock for Southampton of a capacity large enough to dock the Majestic, which is the largest liner afloat. The working drawings and specifications have been prepared by Clark and Standfield, of Westminster, and we understand that the length of the dock is to be about 960ft. and that it will have a width of 170ft. The tenders must be in by September 6th, when the directors of the company will decide as to which one shall be accepted. This would seem to indicate that the work will be put in hand at an early date, and the decision will be eagerly awaited by British dock builders. We believe we are correct in saying that, owing to the depression in shipbuilding, no floating dry dock of large size has been launched from a British slipway since the close of the war.

The Motorless Aeroplane.

EXPERT opinion is divided on the question of the practical value of the aeronautical experience which is obtained with the air glider, but whatever may be the views held, it cannot be gainsaid that the French and German gliding trials of the last week have, in addition to arousing keen interest in flying circles, established new and surprising records. A British Air Sailing Club is already in course of formation, and a competition under the auspices of the Royal Aero Club is to be held, a prize being awarded for the flight of longest duration made in a motorless aeroplane.

Sunken Cargoes.

ACCORDING to Lord Headley, there are few subjects on which more erroneous ideas are current than the subject of sunken cargoes. The general impression seems to be that immersion for a few weeks means destruction to practically all goods except those enclosed in water-tight coverings. As a matter of fact, steel goods and machinery which have been under water for eighteen months and more are often found to be practically in as good a state as when they left the factory. The case is recorded of a turbine steamer which had suffered so little after eighteen months below the surface of the sea that after being raised she was actually got off under her own steam after very little overhauling had been done. Perishable cargoes apparently suffer little damage after a film-like casing is formed around the substance. These remarks are interesting in view of the various salvage schemes that are now being planned or undertaken.

The Sukkur Barrage.

THE Province of Sind, a large tract in India mainly devoted to agriculture, unfortunately lacks the greatest necessity for its advancement—water. The main supply is provided by the river Indus, but to the tracts of land far removed from the river it is always a vexed question as to where a sufficient supply is to be obtained. The other sources of water supply are equally unsuitable, for the rainfall of the province is very poor, indeed almost precarious, being no more than 5in. or 6in. in the year, while the only remaining method, well irrigation, is too costly to be adopted by the poor ryots. The subsoil water, unlike that of other parts of India, is only to be found at a depth of from 20ft. to 30ft., and in some districts only at twice that depth, so that the digging and working of brick-lined wells is a costly business.

But one expedient, therefore, remains—flow irrigation—which is employed as much as possible by means of inundation canals, designed to convey the surplus waters of the Indus River very close to the cultivators' grounds. These canals, which are neither simple to construct nor to maintain, owing to the Indus being erratic in its ways, derive their supply of water through a cutting in the bank of the river when it rises during the rainy season or owing to the melting of the snow on the Himalayas. There is, therefore, but a limited scope for meeting the requirements of the agriculturist.

At present, of the total crops cultivated, about 87.5 per cent. are *kharif* crops—that is, those crops that are grown during the summer season—whereas the *rabi* crops, those grown during the winter or rainless season, form one-eighth of the total. Even this low percentage is dependent upon the heavy watering at the end of the *kharif* season, which goes by the name of *bosi* cultivation. The *rabi* cultivation extends over 100 to 120 thousand acres only, and it is to increase this acreage by eleven times that the Rohri Canal project has been devised. This canal, it is confidently anticipated, will increase the cultivation Sukkur Barrage scheme will draw their supply of water direct from the Indus River and carry it to the several districts of Sind, where it can be made suitable use of by the agriculturists. We understand that the Rohri Canal will be the largest of its kind. The levels have been so arranged that the canal will have water at maximum supply level all through the year. Its full supply level is fixed at R.L. 193, the corresponding full supply level in the river being 193.5.

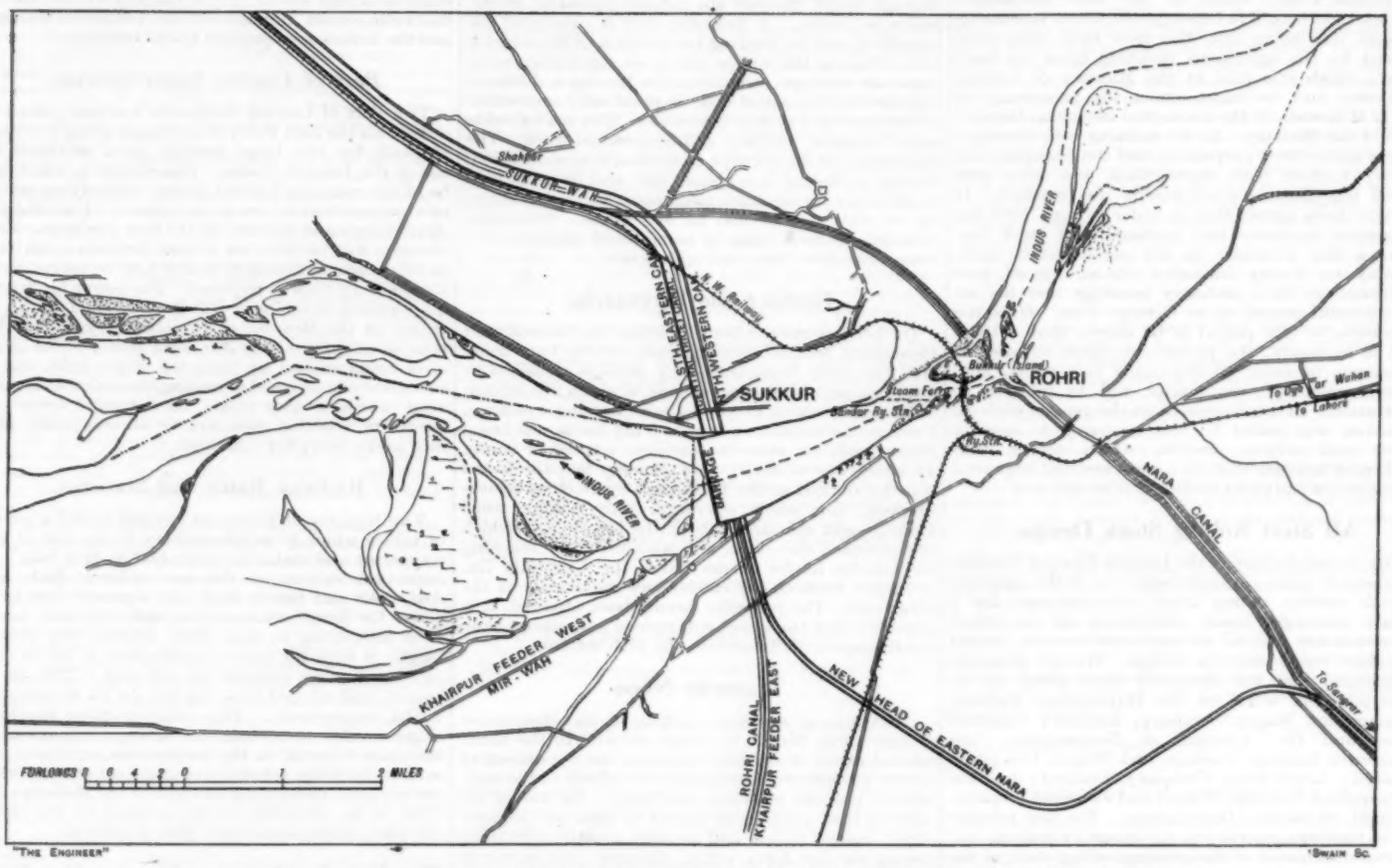


FIG. 1—PLAN SHOWING POSITION OF THE PROPOSED SUKKUR BARRAGE AND THE DIRECTIONS TAKEN BY CANALS]

It will command about 5000 square miles, its length will be 198 miles, and the discharge will be 10,992 cubic feet per second (cusecs) during the *kharif* season and 10,448 cusecs during the *rabi* season. This canal will take off from the left bank of the river at the site of the barrage. Other principal canals on the left bank will be the Khairpur feeders, east and west, 60 and 80 miles long and designed to carry 2094 and 1940 cusecs respectively.

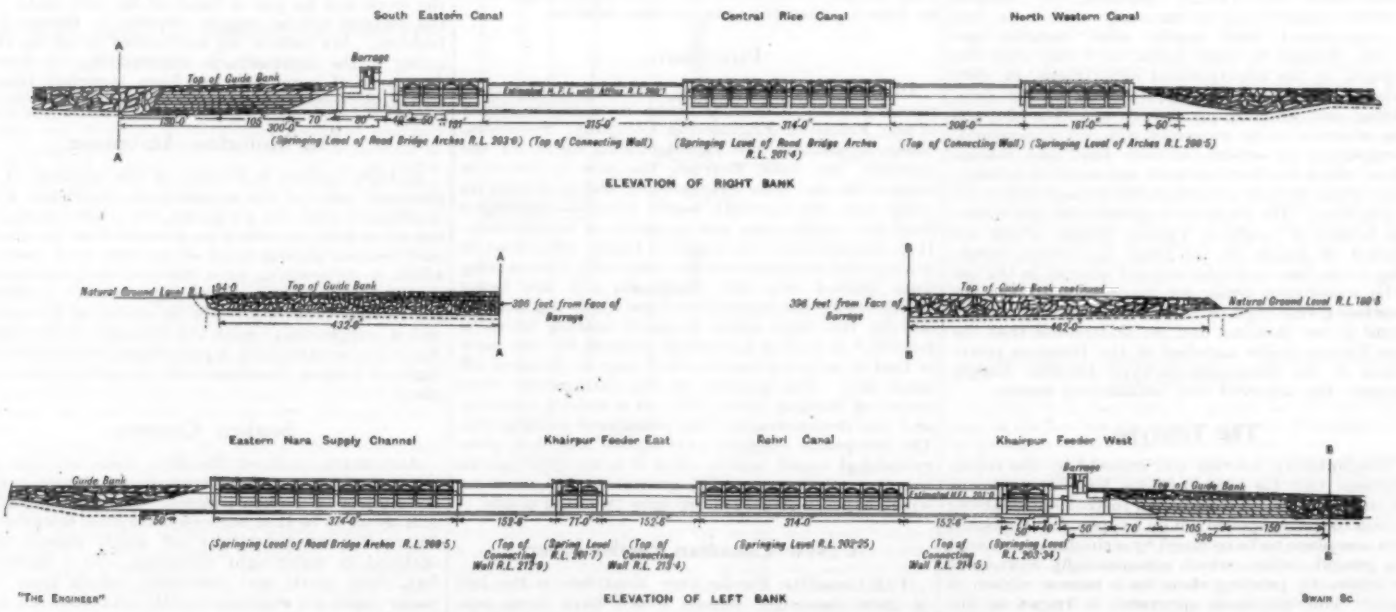


FIG. 2—ELEVATIONS OF BARRAGE WORKS SHOWING CANAL INLETS

The Rohri Canal will carry out its work through the agency of subordinate channels—seven branches (each carrying at least 200 cusecs)—the total length of which will be over 200 miles, distributories (carrying between 50 and 200 cusecs), and minors (carrying less than 50 cusecs), all aggregating 2300 miles. Besides these, there will be about 400 miles of main drains and 370 miles of branch drains. On the other

from its present figure of 680,000 acres to 2,053,344 acres. It will be a perennial canal as contrasted with the inundation canals described above. The Secretary of State has accorded his sanction to the project, and all that now remains is for the necessary capital to be found to make a beginning of this colossal scheme possible.

The Rohri and other canals that form a part of the

bank of the barrage, namely, the Sukkur side, there will be constructed another series of canals. The principal canals of this group will be the North-West Canal with Khirthar Branch, the Central Rice Canal with the Begari Rice Branch, and the South-East Canal. The relative positions of all the canals and other works is shown clearly in Fig. 1.

The Barrage.

The drawings Figs. 2 and 3 show the barrage. This dam will hold up water to a height of over 18ft. by means of Stoney sluices. The actual height of the works will, however, be more than that of the gates, 18½ft. The barrage will have two bridges at different levels. The one on the up-stream side will be at a higher level and carry the travelling cranes used for operating the gates. That on the down-stream side will have a roadway, either 16ft. or 18ft. wide, with parapets. There will, of course, be a path or two paths for those who wish to cross on foot from one side to the other, and also all the other common features of such structures.

The table given below shows the levels and heights of the barrage superstructure, which will be of masonry, not of steel, as was formerly proposed, and which is estimated to cost Rs. 28,05,604 with the cranes and Rs. 24,60,683 without.

Superstructure details.	Levels.	Heights (above barrage floor). Feet.
Upper parapet	R.L. 242.0	.. 66.0
Floor of bridge	R.L. 238.5	.. 62.5
Upper springing	R.L. 219.0	.. 43.0
Lower parapet	R.L. 219.0	.. 43.0
Road surface	R.L. 215.0	.. 39.0
Lower springing	R.L. 201.0	.. 25.0
Highest estimated flood up-stream, with afflux	R.L. 200.12	.. 24.12
Highest estimated flood below piers	R.L. 199.13	.. 23.13
Highest recorded flood ..	R.L. 198.04	.. 22.04
Estimated water level between piers for highest floods	R.L. 196.0	.. 20.0
Top of gates	R.L. 194.5	.. 18.5
Barrage floor	R.L. 176.0	.. 0

The barrage below Sukkur will be over 7 furlongs in length, the high-level bridge with its land span and terminal towers being very nearly 5000ft. The barrage will have no less than sixty-six spans, each with an opening of 60ft. At either end there will be provided openings or sluices through which silt, &c., can be washed away. These scouring sluices are distinct from the ordinary sluices in the centre of the structure, from which they will be partitioned off by means of dividing walls. The barrage will be founded on sand, according to the well-recognised principles of such foundations, and will have a masonry floor and superstructure, piers, arches, roadway, craneway, &c. The movable cranes for operating the gates will probably be worked by electricity, as this is calculated to facilitate considerably the moving of the massive gates in cases of emergency, when a few seconds' delay might make all the difference between safety and disaster. The barrage will, of course, be protected by aprons of concrete blocks and stone pitching on both sides, and there will be a steel sheet curtain of piles driven below the barrage floor. The low-level road bridge at R.L. 215.0 (39ft. above the barrage floor) will be separated from the high-level bridge, on which a track will be laid for the locomotive cranes, by a gap for the Stoney gates and their counterweights. The latter devices will be framed in reinforced concrete; slabs, beams, &c., all being of that material.

The drawings accompanying this article, which have been reproduced and abridged from Mr. Musto's reports, as have also several of the details of the project itself, are quite clear and require no explanation. An examination of them will convey better than a verbal description an idea of the size and utility of the scheme.

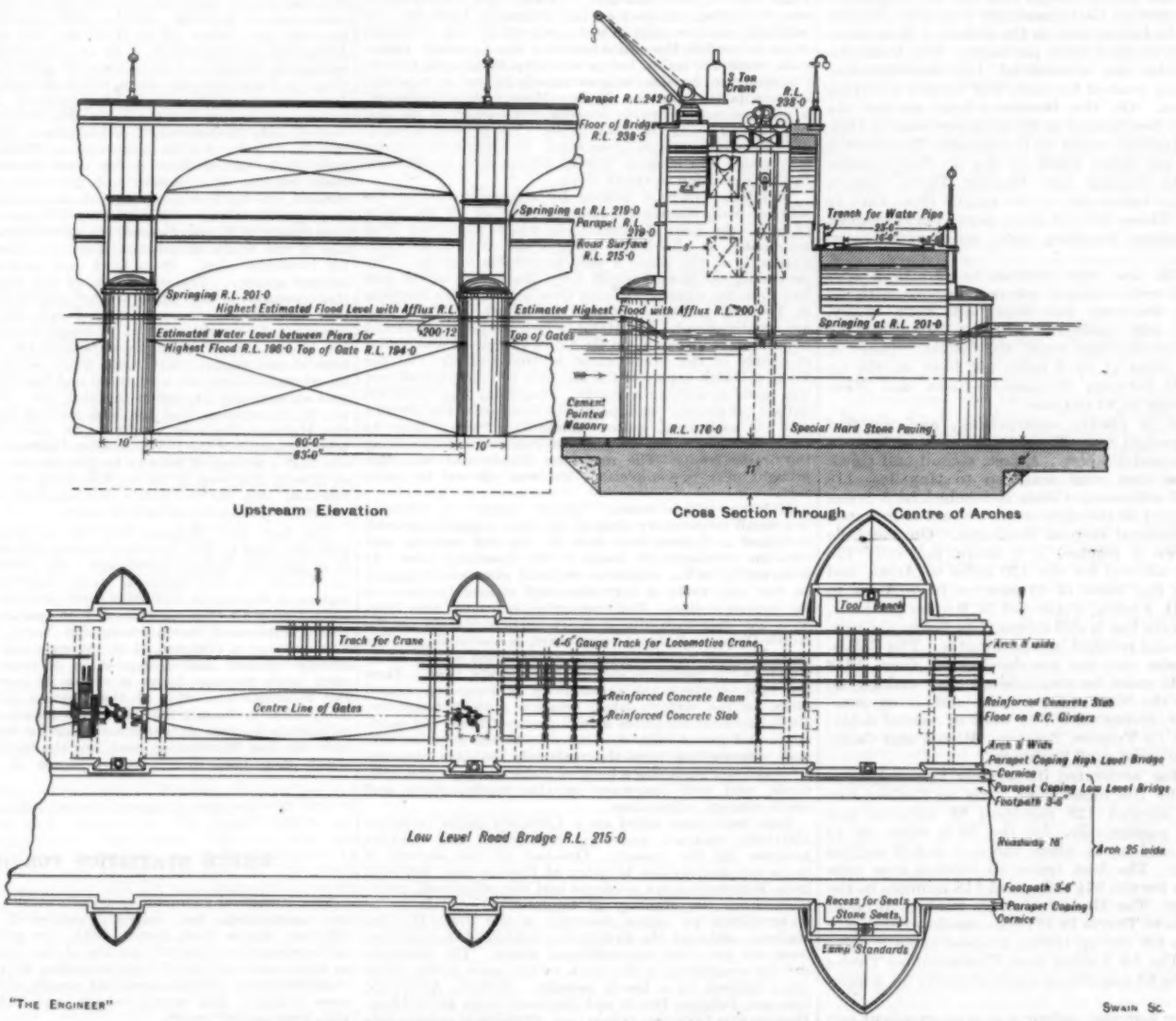


FIG. 3—PART ELEVATION, SECTION AND PLAN OF PROPOSED SUKKUR BARRAGE

French Summer Railway Services in 1922.

Since the war the French railways have made considerable progress towards attaining their pre-war speeds and in increasing the facilities for cross-country travelling. This year the result is a proof of their wonderful energy, and is most creditable, especially for the new services both from Paris and for cross-country journeys by through carriages and through trains.

French railways radiate from Paris, and up to quite recently journeys were difficult to make without passing by there. However, this is changed, and a great deal of attention has been paid to these services and good connections in junctions. The recovery of Alsace-Lorraine and the territory of the Sarre being also separated from Germany, has enabled many new through services to be arranged.

The rearrangement of the map of Europe has changed the routes used by the international trains in many cases, and one new train *de luxe* has been started for the Orient, called the Simplon-Orient express, which now follows the Simplon route to Milan and thence on to Venice, Trieste, Bucharest, Belgrade, Athens and Constantinople. This train has a connection from Bordeaux and La Rochelle *vid* Limoges, Lyons and the Mont Cenis.

The Strasbourg service includes through coaches from Bordeaux, Mantes, the Riviera, Montluçon, *vid* Dijon, and there is a through train from Sarrebruck to Dijon *vid* Metz and Nancy. There are also through services between St. Malo and Bordeaux, Cherbourg and Rouen, Angers and St. Brieuc to Tours, Tours to Lyons, Geneva to Portbou, Bayonne to Avignon, Bordeaux to Vichy, Nancy to Nevers, Lille to Dijon, and Amiens to Havre, among the most interesting. While, of course, there are Paris services to the occupied Rhenish provinces, Luxembourg, Belgium, Holland, Switzerland, even to Germany and Austria. If on some lines the speeds do not appear so high, it must be borne in mind that train loads have increased considerably, and in many cases gradients and new permanent way work are a heavy handicap.

The Etat, though its bookings are not spectacular, gives a thoroughly sound service, and timekeeping and making up for delays is excellent. Its locomotives are very heavy and the gradients on the Cherbourg line are bad, but the fine new 4–6–2 engines are capable of dealing with the traffic most satisfactorily. The line's rolling stock of all classes is comfortable and clean and runs most smoothly. On the Havre route the best train out to Rouen, 87½ miles, takes 112 minutes, while there are six in 126 minutes. The up trains take from 116 to 129 minutes, but follow the Argenteuil route in some cases. Water troughs have been laid down on the Cherbourg line at kilometre post 114, enabling the journey between Paris and Trouville, 138 miles, to be run without a stop, but at moderate speeds. The working performances on this section of the line is excellent, time being readily regained with loads of up to 450 tons. The Brest line is well served, Brest, 309 miles, being reached in 11 hours from Paris, with 74 minutes lost in stops; while through trains run to Angers, St. Malo, Dinard and other stations.

The old Etat system presents no special feature, the long non-stop runs from Chartres to Thouars being broken at Saumur, and speeds are moderate.

The Paris-Orleans has considerably accelerated its

services generally, and the Sud express, since August 1st, re-enters the Town Station at Biarritz. The night train *de luxe* to the Pyrennees and Irun is also running, and a new limited service to Luchon, Lamalou, Vernet les Bains and Font Romieu is running *viâ* Limoges and Toulouse. This new train has the fastest booking of any train from the Austerlitz Station to Les Aubrais—89 minutes for the 73¾ miles—and on to Toulouse the speeds approximate those of 1914. The two trains *de luxe* to the Spanish frontier are booked at 50 miles per hour from Les Aubrais to Bordeaux, with a burst of 53.1 miles per hour from the former point to St. Pierre des Corps. The other trains now all carry second-class passengers and third in many cases. On the line to Nantes the best booking is only fractionally under 50 miles per hour from there to Angers, but the train now has second-class coaches. The company is using the line *viâ* Vendôme for some of these expresses instead of that *viâ* Les Aubrais.

The Midi has a most enterprising service, in some cases better than 1914 bookings being in force. Bordeaux to Agen, 85 miles, is now booked in 100 minutes, a speed of 51 miles per hour, and the speed on to Montauban is practically the same. Toulouse to Carcassonne, 56.8 miles, is now run in 72 minutes, including a slow at Castelnaudary, with over 300-ton loads, and the fastest run on the system is from there to Narbonne at 52.6 miles per hour. The Toulouse-Bayonne trains are accelerated, but electrification, which is being pushed forward, will furnish a further improvement. On the Bordeaux-Irun section the trains *de luxe* are booked at 50 miles per hour to Dax, and on the famous secton on to Bayonne the speed is 50.6 miles per hour, while on the up Sud express, owing to its running into Biarritz Town Station, 10 minutes is taken out of the engine from Dax to Bordeaux. These are not mere paper performances, the new engines handling their trains most satisfactorily.

The P.L.M. has been content to furnish a convenient and well-arranged summer service with no outstanding features, but loads are very heavy. Marseilles is only reached in 13 hours 10 minutes by a first and second-class train, the fastest. There is, however, a burst at 50.3 miles per hour on the up Vichy rapide between Pougues-les-Eaux and Montargis, 78 miles in 93 minutes.

The Nord is always enterprising, and we find Boulogne reached from Paris in 3 hours with stops at Abbeville and Etaples. A first, second and third-class express now runs non-stop to Noyelles, 118 miles in 137 minutes; Calais is reached in 3 hours 35 minutes, and on the up journey 3 hours 40 minutes, with an additional stop at Boulogne. On the Lille line this town is reached in 3 hours, and only 128 minutes are allowed for the 120 miles to Arras, and there is one fine burst of 45 minutes from Arras to Longueau, 41.2 miles, a speed of 54.9 miles per hour. The St. Quentin line is still slower than before the war, that town being reached in 110 minutes. The Calais-Boulogne-Swiss services are decelerated from 1914 bookings. It must be remembered that making up lost time on the Nord still prevails, and is as practised as ever, giving some fine work in case of delay. The lines to Le Tréport, Soissons, Hirson and Calais to Lille show some good bookings.

The Est has acclerated its services very considerably, and the 108 miles from Paris to Chalons-sur-Marne are allowed 125 minutes; 63 minutes and 62 minutes respectively, for the 50.6 miles on to Bar le Duc and back, where the new 4–6–2 engines are working. The best trains to Rheims now take 115 minutes for the 97½ miles and 118 minutes in the up direction. The Basle trains are booked to cover the 104 miles to Troyes in 121 minutes down and only 111 minutes for the up trains, a speed of 56.2 miles per hour. The 59.3 miles from Chaumont to Troyes are booked in 63 minutes, a speed of nearly 56.5 miles per hour.

The Alsace Lorraine railways give an excellent service of trains at speeds which are satisfactory when the frequent stops are taken into account. The best train runs the 27½ miles from Strasbourg to Selestat at exactly 50 miles per hour, while the majority of the expresses are booked at from 45–50 miles per hour, start to stop.

This short review of French summer services in 1922 shows the wonderful progress made in re-establishing their train service. If speeds are not so high as in 1914, the number of trains has increased. Rolling stock is more comfortable, and second and even third-class are run on more trains, while through trains and coaches render travelling much easier than before. These paper speeds are improved on in practice, and the very long distances run preclude a very sharp time table booking, as lost time must be able to be made up.

No little interest is being taken in trading circles in the question of the information that the Ministry of Transport will seek from the railway companies under section 77 (2) of the Railways Act, 1921. It therein recites that the companies shall furnish the statistics and returns named in the eighth schedule to the Act. This contains nineteen items, but the Order is to be subject to such variation as may be agreed between the Minister of Transport and the Railway Companies' Association. It is important to note that, in view of the grouping of the companies, the returns are to be subdivided in accordance with such operating areas as may be agreed.

Hulutao Harbour, Manchuria.

The following particulars concerning the harbour which the Chinese propose to construct at Hulutao, in the north of the Gulf of Chihli, supplement those given by our Chinese correspondents in the issues of July 14th and to-day, and are taken from the Tokyo *Trans-Pacific*.

The interest displayed by Chang Tso-lin in Hulutao port prior to his recent military misfortune, gave this project new life. Tuchun Chang's prime interest was, of course, inspired by military exigency, but if eventually the scheme is carried to fruition, the benefits to trade and industry in Manchuria will be great.

Hulutao lies in the north-west corner of the Gulf of Chihli, and only five miles from the main line of the Peking-Mukden Railway. A full-gauge branch has already been constructed to the site of the project. Engineers and harbour experts of the Chinese Government and various commercial attaché offices in China declare Hulutao to be the only practicable site for a deep-water port of any magnitude in this region. Along the entire coast of Chihli and Manchuria, the foreshore of the Gulf of Chihli is for the most part extremely shallow, and miles of dredging would be required to allow approach of a ship of more than 8ft. or 10ft. draught. Dairen and Chinwangtao are, of course, exceptions; but Dairen is Japanese. In addition, goods coming in and going out by way of Dairen must be hauled the entire length of the Liaotung peninsula, some 150 miles, before reaching Manchuria proper. Chinwangtao, besides being extremely limited in capacity, is monopolised by the Kailan Mining Administration, a predominantly British concern, for export of its coal from the adjacent Tongshan Mines. The present capacity of Chinwangtao is only seven ships. Construction is under way which will increase this to fifteen, with an ultimate further extension to thirty ships.

Hulutao, which is formed by encroachment on the alluvial plain elsewhere bounding the Gulf by the range of hills—the Liao Mountains—in which the Great Wall terminates, in addition to being a site without an alternative, is on the whole a very favourable location. The prevailing north-west winds keep this corner of the gulf free from ice, whereas the tiny river on which the shipping of Tientsin is dependent and its mouth at Taku Bar are usually closed. The Halutao Port project was mooted about two years ago when Mr. Chow Chwen-an was placed in charge of the development scheme and Mr. van der Veen, a Dutch expert of the Ministry of Communications, was made consulting engineer. Something like 1,200,000 dollars has already been spent; the first care of the director and his assistants, quite Chinese-like, having been to erect for themselves magnificent residences overlooking the water front. The necessary breakwater was also brought near to completion, but was allowed to go to ruin.

Hulutao, which means "gourd island" in Chinese, is a small promontory shaped like this vegetable growth so famed in Chinese lore, with the big end hanging out into the northernmost reach of the Liaotung inlet. It is curved in such a manner as to make what would appear on the map to be a very desirably shaped harbour on its northern side. Unfortunately, however, this bay, as is the case with almost every such formation on the North China and Manchurian coast, is too shallow. The harbour must consequently be constructed at the bluff, which is the southern side of the gourd's head. Here the hills of which the promontory is composed crowd down to the water's edge, creating a deep foreshore. The scheme contemplates levelling one of these red sandstone and gravel hills, erecting warehouses upon its site, and constructing from the materials that are removed a breakwater enclosing a body of water in shape of a half-circle, and with gateways on the north-eastern and south-western extremities.

Bids have been asked on a 7,000,000 dollar (roughly £700,000) contract, including breakwater and docking facilities for five vessels. One-half of this amount is to be supplied by the Ministry of Finance and deducted from Manchurian tax revenues and the other half, nominally from the Ministry of Communications, is to be underwritten by excess revenues of the Pekin-Mukden Railway, although the British lien-holders of that concern have not yet given unconditional assent. The contracts call for completion of the work within seven years, delay being subject to a heavy penalty. British, American, German, Belgian, Dutch and Japanese firms are bidding. How far this 7,000,000 dollars (say, £650,000 at present rate of exchange) contract will fall short of supplying the real needs of the port, however, may be seen by contrast with the Dairen port expansion scheme. After an expenditure of 30,000,000 yen (say, £2,800,000) Dairen is able to take care of only twenty-five vessels and its development plan calls for further expenditure of 25,000,000 yen (say, £2,300,000) by 1925.

Coal deposits of considerable size are found in the mountains near Hulutao, and the Chinese are very optimistic that operation of these mines will provide immediate revenues for the port. Of the deposits which have thus far been discovered in three regions, the principal one is inside the parabola described by the Great Wall just before it meets the sea. Five attempts have been, or are being, made to exploit this coal, but the rugged nature of the country gives rise to great difficulties. The most important mine is the Liuchiang, or "Willow River," which is entirely Chinese owned and is managed by a Cantonese named Li Shu-chen. Eleven shafts have been sunk, three of which are perpendicular and eight on an incline. Eighty to one hundred men are employed. The product is a rather poor grade of hard coal, which is, however, satisfactory for household use. This mine is connected by its own light railway with the Peking-Mukden line at Chinwangtao, from which it is 12 miles distant, but owing to the many switch-backs resorted to for making grade, the railway is several miles longer than this. This mine is sending out about 100 tons of coal daily, which is sold at Chinwangtao at 5.80 Mex. dollars per ton. Three miles back in the hills from this mine is the Paohsing mine, once a German enterprise, but closed since the war. Two miles still further back is the Sino-Japanese operated Taichi mine. On the opposite side of the circumference of a circle which might be drawn through these three workings, are the Chengchiang deposit, now in process of being opened by a Chinese named Hsu, and the Hsingyeh holding, once the property of President Feng Kuo-chang, but which has passed from one of his successors to another, and is now owned by Chi Hsieh-yuan, Tuchun of Kiangsu. Here, thirty men are employed who dig out about 20 tons daily, from one shaft and one well. It can be readily seen that the latter four mines are very unfavourably situated, due to the fact that the first, or Liuchiang, mine owns the light railway. They are, therefore, compelled to transport their product on donkey-back to the Liuchiang minehead and sell it to their competitor, who will not allow them the use of its railway. An effort is being made to combine the holdings of this area. If it fails, the only alternative is construction of separate light railways by the various owners.

Since this coal is so near to Chinwangtao it may be questioned how Hulutao may ever hope to become the shipping point therefor. It must be remembered that, aside from the fact that Chinwangtao harbour is geographically restricted in size, it is absolutely under control of the Kailan Mining Administration, which is not likely to give budding competitors shipping facilities at a price smaller than the haulage cost to Hulutao 100 miles further north.

The other known coal deposits in the neighbourhood of Hulutao are the unworked bed at Lishuko, about 30 miles north-west of Suihung, which is the point at which the ten-mile spur takes off to Hulutao; the newly opened Lilungkok deposit, which is to be connected by a light railway to Shihshan station, some 30 miles north of Lienshan; and the Tayaoko mines, which are under joint Sino-Japanese operation, and which possess a 27-mile light railway connecting with the Peking-Mukden line at Nuerho station, only 30 miles north of Liemshan. The latter two may be considered to be in one region. These mines have been sunk, but of these it has been necessary to close three because of explosion and fire, and one has been flooded, leaving five operating. About ninety miners are employed, and the output of some 70 tons of coal daily goes chiefly to Kopangtzu and the towns along the branch line of the South Manchurian Railway, where it is used for household fuel. It is hard and smokeless, but of inferior quality. The impression of the observer is that the operators of this mine are not sincerely doing their best towards its development. Roads and equipment appear to be poorly kept up. Foreign experts, however, are by no means optimistic regarding the development here of coal export trade, since these deposits, as almost all others in China, are very tilted and broken, making the coal exceedingly expensive to bring out. These experts are of the opinion that the best method for developing the Hulutao Harbour would be to place it under the administration of the Pekin-Mukden Railway. They point out that a system of railway feeders running north as far as Siberia and west as far as Manchuria is a much more essential step in the port's development than is construction of large wharf-side capacity.

The fact that Hulutao will be an entirely Chinese port will tend to give it favour among the more patriotically inclined Chinese merchants. Its situation is most convenient to the principal grain and soy-producing regions of Manchuria, and holds forth promise of becoming second only to Chinwangtao and of greater importance than Tientsin and Dairen among the North China ports. The opening of Hulutao, if its management be approximately efficient and if imposition of taxes and likins upon trade be kept down, is certain to increase greatly the economic standing of the Chinese in Manchuria. They need no longer feel that it is necessary for them to hesitate in their development plans for fear of Dairen, now the best Manchurian port, nor the faction or nation which may hold their northern egress at Vladivostok.

WRECK STATISTICS FOR 1921.

The statistical summary of vessels totally lost, broken up, condemned, &c., recently published by Lloyd's Register, shows that, during 1921, the gross reduction in the effective mercantile marine of the world amounted to 559 vessels of 674,257 tons, excluding all vessels of less than 100 tons. Of this total 344 vessels of 536,537 tons were steamers and motor vessels, and 215 of 137,720 tons were sailing vessels.

The statistical tables exhibit interesting data as to the relative frequency of the different kinds of casualty, &c., which conclude the existence of vessels. Strandings and kindred casualties which are comprised under the term "wrecked" are the most prolific cause of disaster. To such casualties are attributable 45.16 per cent. of the losses of steamers and motor vessels, and 38.8 per cent. of sailing vessels. Cases of abandoned, foundered, and missing vessels are, no doubt, frequently more or less similar in the circumstances of loss. If these be taken collectively, they form 30 per cent. of the steamers and motor vessels, and 35½ per cent. of the sailing vessels removed from the mercantile marine during 1921, owing to casualty. The amount of tonnage broken up, dismantled, &c.—not in consequence of casualty—in 1921 was 93,431 tons.

The return has been prepared in such a manner as to enable a comparison to be made between the percentage of loss suffered by each of the principal merchant navies in the world. Great as the absolute annual loss of vessels belonging to the United Kingdom appears to be, it actually forms but a very moderate percentage of the mercantile marine of the country. A new table shows the number and tonnage of steamers and motor vessels lost throughout the world owing to marine and war casualties during the last 20 years, distinguishing the losses of the principal maritime countries. Cases of vessels broken up, condemned, &c., not due to stress of weather, are excluded. This table gives for each country the percentage lost of the total tonnage owned. During this period of twenty years—excluding the five war years 1914-18—the average percentage of loss of United Kingdom vessels only amounts to 1 per cent. of the tonnage owned.

Railway Matters.

The London, Brighton and South Coast Company announces that the extension of its electrification to Coulsdon is to be put in hand at once, and, it is hoped, completed next year.

The stadium and exhibition grounds at Wembley will be well served by railway communication, as they are close to the London and North-Western, Midland, Great Central and Metropolitan Railways.

At a conference, held in Glasgow, on August 8th, between the chairmen of the Scottish railway companies and representatives of the Federation of British Industries, it was agreed that there should be a general reduction in Scottish railway rates, practically similar to those made earlier in the month by the English and Welsh companies on the 1st inst.

The Inter-State Commerce Commission, after hearing, has confirmed the Order as to automatic train control, which was the subject of our leading article on February 3rd, last. Forty-nine companies have to install some system of train control between certain points specified in the Order and equip the whole of the engines in one passenger division.

The Great Central Railway Company's war memorial at Sheffield was recently unveiled by Field-Marshal Earl Haig. It was to the memory of 1304 Great Central men who gave their lives in the Great War, and was erected by the subscriptions of 390 shareholders and 3783 officers and servants. Out of the 10,177, or 29.38 per cent. of the total staff, who joined the colours, 213 received honours.

Changes are announced in the administration of the Northern Counties (Ireland) section of the Midland Railway. Mr. James Cowie, the manager and secretary, is retiring and being succeeded by Mr. James Pepper, the assistant goods manager of the Midland Railway. We have seen it stated that Mr. Pepper is to be the engineer also, which suggests that Mr. Bowman Malcolm, the engineer and locomotive superintendent, is retiring as well.

The suspension of the London and South Western train service between Ludgate Hill and Tooting, to which reference was made herein on the 11th inst., reveals the necessity for uniformity in equipment for electrical operation on railways. These trains were conveyed by London and South-Western locomotives over South-Eastern and Chatham, London, Brighton and South-Coast and its own metals. This future difficulty has, possibly, prevented the restoration of the service.

Cable advices state that Mr. W. A. Webb, an American railway officer—at one time general manager of the Wichita Falls and North-Western Railroad, Texas—has been appointed chief commissioner of the South Australian Government Railways. If this be true, it is the second time within four or five years that such an appointment has gone to an American, a fact which is to be regretted when it is remembered how many excellent railwaymen are likely to be displaced in this country owing to the grouping of the railways.

In this column of our issue of April 21st, we drew attention to what we considered an unnecessarily expensive train—the 1.35 p.m. Brighton company's train of three bogie coaches which ran from Victoria to Fratton without a stop. On August 9th this train was put on a better commercial basis, and it now calls at Arundel at 2.59, and gives a connection with Littlehampton and Bognor. A new train to Bognor at 6.15 p.m. from Victoria runs *viâ* Three Bridges, and is due at Arundel at 7.36, which is 4 min. faster than the Portsmouth train.

One passenger was killed on Monday morning last in a collision between two workmen's trains between Gravesend, Central, and Higham, on the South-Eastern and Chatham main line to Maidstone. The first train was standing at Milton Range halt, being detained there by some of its passengers having been knocked down by a light engine which they had not seen approaching on the up line, and, whilst so detained, a second down train ran into the first. How this came about would probably be revealed at the Ministry of Transport inquiry, which is being held as we go to press. This is the second fatal passenger train accident of the year. The first, when one passenger was killed, was at Blisworth, on January 27th.

Almost exactly a year ago—this column in our issue of August 19th, 1921—we referred to the difficulty in grading signalmen. Their duties vary considerably; some have many signal lever movements, some many point lever movements, others have few lever movements, but several block signal indications. Yet others have busy level crossings to attend to, or opening bridges, whilst some have long tunnels to protect. Then, of course, there are combinations and modifications of these conditions and there are a few power-operated cabins. Not until now, therefore, although the matter has been in hand since March, 1920, has it been possible to decide a method of classification for signalmen in order to determine their pay.

An American contemporary, having mentioned that the Ministry of Transport has no power to order automatic train control, we would say that few are aware of the power given by the Railway Employment (Prevention of Accidents) Act, 1900. If the Ministry can show that train control would reduce the number of accidents to railway servants it can make an Order for its provision. The actual wording is:—"The Board of Trade (now the Ministry of Transport) may . . . require . . . . the use of any . . . appliance which has been shown to the satisfaction of the Board of Trade to be calculated to reduce danger to persons employed on a railway." The procedure is by rules, but no rule can be put into force before publication, and, if opposed, the Railway and Canal Commission shall decide if the opposition is reasonable. If it be determined by the Commission that the objection is reasonable the rule shall not be made. For new railways the officers of the Ministry have, under the Act of 1842, very wide powers which were extended under the Act of 1871, to new stations, junctions and connections.

Notes and Memoranda.

An indication of the progress that is being made in the use of electricity in China is given by the fact that current is now supplied during the day in several important centres instead of the plant being run during the night only, as has hitherto been the practice—Nanking, Soochow, and Hangchow are cases in point. As regards electrical accessories, fittings, and lamps, Japanese manufacturers have held the market for wires and cables, porcelain insulators, &c., Dutch manufacturers for lamps, and American manufacturers for the better class fittings and glassware. Towards the end of the year, German glassware fittings appeared on the market at prices which undersold the American product. Altogether this line of trade is in a flourishing condition, with good prospects ahead.

A new plant and process for making large "seamless" tanks and sheet steel vessels, used by the Blaw-Knox Company, is referred to in a recent issue of *Science Abstracts*, issued by the Institution of Electrical Engineers. Briefly, the method consists in assembling the plates, bent or pressed to shape, with lap joints, tacking them at intervals by a torch weld, placing the assembled vessel on a special carriage, and welding the seam by a pair of gas flames, one above and one below. When that region has been brought to a proper heat, the upper and lower torches are quickly replaced by an air hammer and anvil respectively, and the hot spot is welded and worked down flat. This cycle of operations is repeated until the seam is continuously welded from end to end. When all the seams are finished, the whole article is annealed, all fixtures applied, and if it is a pressure vessel it is subjected to hydraulic test

In the course of a paper read before the American Society of Mechanical Engineers, Mr. L. Cammin refers to the work of Andrew Shanks, a British inventor of the middle of the nineteeth century, who, to cast a thin-walled pipe, cut it, and then by careful annealing and hammering flattened it out to form a plate. The author goes on to point out that the use of a hot mould now makes it possible to secure comparatively thin-walled castings in large sizes. A process has been worked out, though not yet applied on a commercial scale, in which a cylindrical casting is made in such a manner that a longitudinal split about ¼in. wide is produced. The split cylinder as it comes from the mould is sent first through a jig where it is flattened out on its own heat, and then to rolls, of which there are at least two, one for sizing and the other for finishing. This process is attractive, as it does away with the ingot-casting work, soaking pits, blooming mill and a large proportion of the rolling equipment.

Recently nine American companies interested in the manufacture of wireless direction-finders met at the Bureau of Standards to confer with the Assistant Secretary of Commerce, the Bureau of Lighthouses, and the Bureau of Standards, regarding the production, cost, installation, calibration, and maintenance of direction-finders on board ship. It was announced that the Department of Commerce has decided to install the following wireless beacon stations:—Boston, Nantucket, Cape Charles, Columbia River, Puget Sound, and, if funds are still available, Delaware Bay, Los Angeles, and Blunt's Reef. These are in addition to the two new wireless beacons at Diamond Shoal (off Cape Hatteras) and San Francisco Light Vessel. Three other wireless beacons have been in operation in the vicinity of New York Harbour for over a year at Ambrose, Fire Island and Sea Girt. As a result of the conference, arrangements will be made through the Bureau of Lighthouses, between the manufacturers of wireless direction finders and the operators of steamships for the trial and demonstration of wireless direction-finding equipment produced by the several manufacturers under practical conditions.

The asbestos deposits of the Province of Quebec, which furnish at present between 85 and 90 per cent. of the world's supply of that substance, are found in a long and narrow zone of serpentine rock which enters Canada from the south, near Lake Memphremagog, and extends in a north-easterly direction, with more or less break, into the Gaspe Peninsula. There are at present six producing centres—East Broughton, Robertson, Thetford Mines, Black Lake, Coleraine and Danville. The asbestos extracted from the mines of Quebec is exclusively of the chrysotile variety, the demand for which has within the past few years been greatly augmented by the new uses found for this material. During 1920 the output of asbestos from Quebec mines amounted to 174,521 tons, valued at 11,758,234 dollars, which is equal to more than 50 per cent. of the value of the Province's total mineral production. The corresponding figures for 1919 were 135,861 tons, valued at 10,932,289 dollars. Practically the entire output of the Quebec asbestos mines is exported, as there is only one concern in Canada manufacturing asbestos products. This factory produces for home consumption and export asbestos slates, shingles, interior and exterior coverings, boards, paper, and undulated asbestos sheets.

In a communicated contribution to the discussion on Mr. F. P. Whitaker's paper on "Rotary Converters, with special reference to Railway Electrification," read before the Institution of Electrical Engineers, Mr. P. Hunter-Brown remarked that unfortunately it did not appear to be sufficiently appreciated that the collecting of current from a slip ring was a combined brush, brush-holder, and slip-ring problem. Investigations made on a number of different alloys suggested that heat treatment of the rings was of greater importance than the chemical composition, or rather that the latter might be varied between quite wide limits, but that the rings must be suitably heat treated after being cast, in order to obtain the best results. In one instance heat treatment reduced the average rate of wear of brushes by 32 per cent. and of the rings by 40 per cent. The function of the brush holder was to enable the brush to maintain as intimate contact as possible with the rings, which, in practice, can never be made mathematically circular. The brush holders should be distributed correctly round the ring. Ring wear was due to three causes, *i.e*, mechanical abrasion, a burning action, and a quasi-electrolytic or arc effect which caused a transference of metal from the ring surface in the direction of current flow.

Miscellanea.

A new seam of coal has been discovered in the Kent coalfield at Cobham, near Chatham.

According to Reuter, the first consignments of goods from Germany which have arrived at Melbourne consist of small parcels, the German merchants apparently being anxious to feel their way at present.

One of the largest electricity supply businesses in the United Kingdom, that of Glasgow, has just emerged from the most successful year of its history. The past year's working showed a net profit of £42,578, the whole of which has been transferred to reserve. The most striking feature in the annual report is the enormous reduction in generating costs.

A Lisbon message says that the Portuguese Parliament has approved a contract with the Marconi Company for the erection of wireless stations in Lisbon, Madeira, the Cape Verde Islands, Angola, and Mozambique, to be ready in four years. A forty years' concession for working them will be granted to a syndicate with Portuguese capital and with a majority of Portuguese directors on the board.

Work is about to be started on the new power station at Lydney, which is intended for supplying power to the collieries and factories of the Forest of Dean and the Stroud Valley. The station will eventually have an output of over 20,000 kilowatts, and will cost, with the transmission lines, &c., about £500,000. The West Gloucester Electricity Supply Company is to be formed to carry on the undertaking.

The articles of association of the proposed British Wireless Broadcasting Company have now been submitted for the approval of the Postmaster-General. Mr. Kellaway is on holiday, and it was stated at the General Post Office on Wednesday that after the permanent officials have examined the articles it may be necessary to forward them to him. In the circumstances it was impossible to name a date for the inauguration of the scheme.

A Madrid message states that a deputation of Spanish mine owners waited upon the Secretary of State to protest against the importation of British coal into Spain. The Minister replied that Britain had insisted as an initial condition of the negotiations for a commercial treaty between the two countries that Spain should take a million tons of British coal. In addition to a million tons, there will be other imports of British coal. The deputation withdrew much dissatisfied with the reply.

Addressing the International Mining Convention at Nelson, the Hon. William Sloan, Minister of Mines for British Columbia, told the delegates that at no time in Canadian history had the mining business of the Province been more to the forefront. Compared with the big mineral States to the south, British Columbia appeared to be particularly favoured, said the Minister. All signs pointed to improvement, and the urge everywhere was towards intensified industrial effort. Mr. Sloan asserted that one of the chief causes of delay in mining expansion was the unsettled conditions of Europe.

The war gave considerable impetus to the production of tungsten in China, and that country now stands as a producer of high rank. In 1916 the exports from China amounted to only 120 tons, but in the following year the figure increased to 1500 tons, and there was a further jump to 11,662 tons in 1918, although this last estimate is contested by various authorities, who place the amount at between 4000 and 6000 tons. With a production even at the latter figure, China's position in regard to this metal is of great importance. It is reported that 100,000 tons of tungsten ore may be regarded as an approximate estimate of the ore "in sight" for the known tungsten-bearing regions of China.

An exceptionally interesting and instructive series of tests on oil circuit breakers have been carried out at Baltimore. No fewer than 200 three-phase metallic short circuits were made directly on the Baltimore 13,200-volt, 25-cycle power system. The maximum generating capacity behind the short circuits was 170,000 kilowatts, and the currents interrupted during the tests varied from 750 to 23,700 ampères. The most interesting feature of the experiment is the fact that it has been proved to be possible to conduct such tests directly on a modern power supply system without damaging its equipment and without seriously interfering with its normal operation, a result which is undoubtedly due to the short duration of the short circuits and to the fact that the system is equipped with a carefully designed and adjusted selective relay system. The individual performances of the circuit breakers are said to indicate that it is possible to design and build switchgear which can be relied upon satisfactorily to interrupt large currents on large-capacity systems many times in succession without damage to the breaker and without a change of oil or other adjustments being necessary.

Various systems of traffic or signal lights have been installed in the United States during recent years in order to ensure safety for the ever-increasing traffic on city streets at night. They have consisted of elevated beacons which are also used to control the traffic; iron, wooden and concrete posts equipped with illuminated globes at their tops; illuminated signs, &c. A recent development in a traffic signal that is discernible by day and by night is the Mushroom light, first used in Milwaukee, and since in many other cities, including Chicago, Cleveland, Minneapolis, Indianapolis, Detroit, St Louis, Kansas City, and many smaller cities. This new light consists of an 18in. heavy ruby glass hemisphere covered with a ribbed steel grating rising 8in. above the pavement. Its hemispherical shape causes the wheels of passing vehicles accidentally striking it to slide off easily without injury either to the light or to the vehicle. In this type of unit two 75-watt lamps are used. This light is designed primarily for use in the centre of street intersections, especially at intersections where traffic is heavy, but where a policeman is not regularly stationed. Its presence in the street ahead immediately denotes to the motorist a busy corner. By dividing the traffic and keeping motorists on the proper side of the thoroughfare, the possibility of accidents is greatly reduced.

WOOD FUEL SUCTION-GAS POWER PLANT AT THE LONELY MINE, SOUTHERN RHODESIA

(*For description see page 114.*)

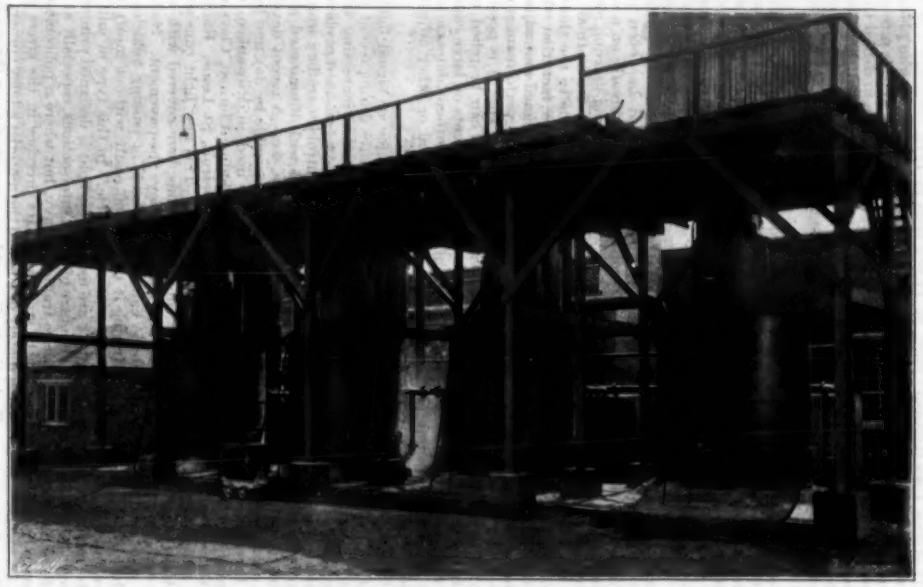


FIG. 1—350-H.P. CROSSLEY WOOD FUEL SUCTION-GAS PRODUCERS

FIG. 2—END VIEW OF GAS PRODUCERS

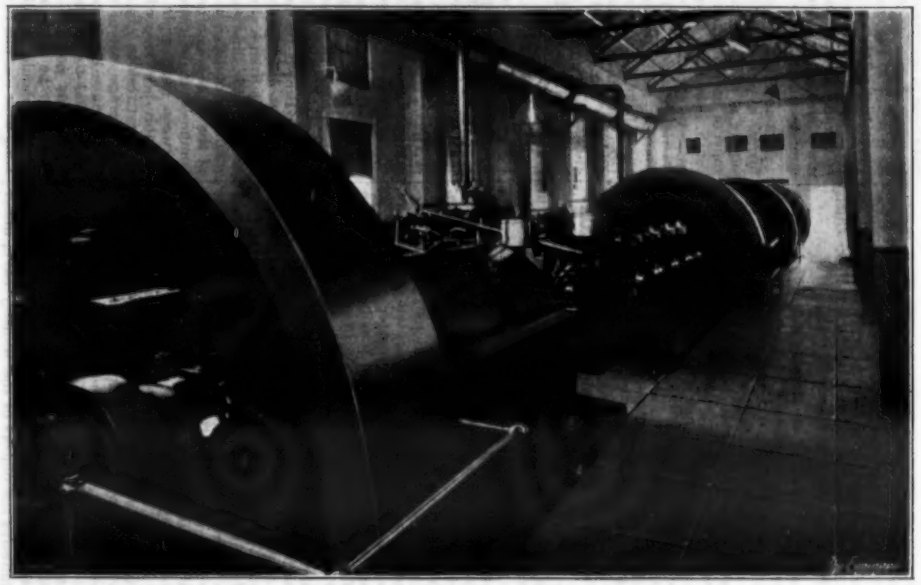


FIG. 3—INTERIOR VIEW OF ENGINE HOUSE

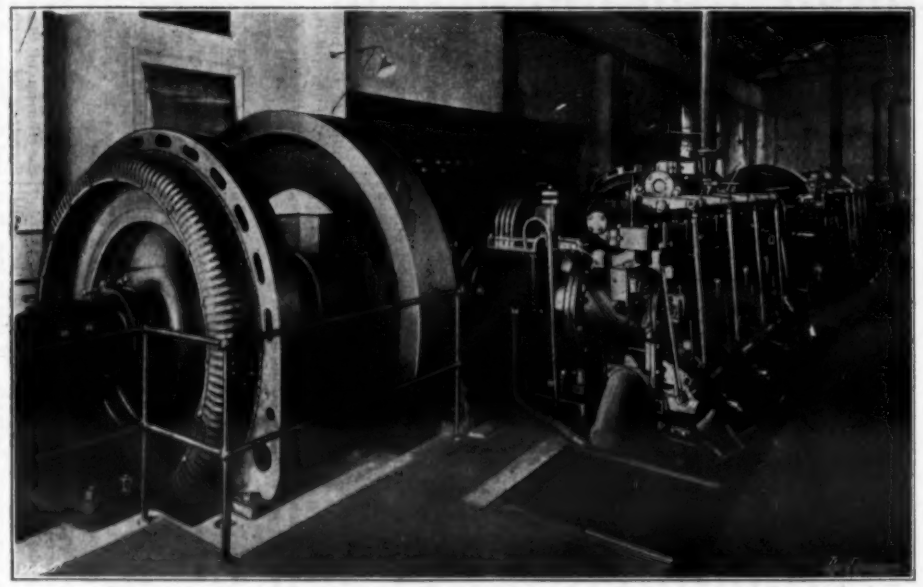


FIG. 4—PREMIER GAS ENGINE DRIVING S.A. GENERAL ELECTRIC ALTERNATOR

AGENTS ABROAD FOR THE SALE OF

The Engineer

BUENOS AIRES.—Mitchell's Book Store, 576, Cangallo.
CHINA.—Kelly and Walsh, Limited, Shanghai and Hong Kong.
EGYPT.—Cairo Express Agency, near Shepheard's Hotel, Cairo.
FRANCE.—Boyveau and Chevillet, Rue de la Banque, Paris.
Chapelot and Cie., 136, Bld. St. Germain, Paris.
BELGIUM.—W. H. Smith and Son, 78/80, Rue du Marché-aux-Herbes, Bruxelles, and 44, Rue Joseph II., Ostend.
INDIA.—A. I. Combridge and Co., Bombay; Thacker and Co., Limited, Bombay; Thacker, Spink and Co., Calcutta.
ITALY.—Maglioni and Strini, 307, Corso, Rome; Fratelli Treves, Corso Umberto 1, 174, Rome; Fratelli Bocca, Rome; Ulrico Hoepli, Milan.
JAPAN.—Maruzen Co., Tokyo and Yokohama.
AFRICA.—Wm. Dawson and Sons, Limited, 7, Sea-street (Box 49), Capetown.
C. Juta and Co., Johannesburg, East London, and Grahamstown.
AUSTRALIA.—Gordon and Gotch, Limited, Melbourne, Sydney, Brisbane, and Perth, &c.
Melville and Mullen, Melbourne.
Atkinson and Co., Gresham-street, Adelaide.
CANADA.—Dawson, Wm., and Sons, Limited, 87, Queen-street East, Toronto.
Gordon and Gotch, Limited, 132, Bay-street, Toronto.
Montreal News Co., 386-388, St. James-street, Montreal.
Toronto News Co., 42, Yonge-street, Toronto.
CEYLON.—Wijayartna and Co., Colombo.
JAMAICA.—Educational Supply Co., Kingston.
NEW ZEALAND.—Gordon and Gotch, Limited, Wellington and Christchurch; Upton and Co., Auckland; J. Wilson Craig and Co., Napier.
STRAITS SETTLEMENTS.—Kelly and Walsh, Limited, Singapore.
UNITED STATES OF AMERICA.—International News Co., 83 and 85, Duane-street, New York; Subscription News Co., Chicago.

Agents Abroad for Advertisements.

UNITED STATES OF AMERICA.—British and Colonial Press, Inc., 736, The Knickerbocker Building, 152, West 42nd-street, New York City.
FRANCE.—Agence Vox, 7, Rue de Surène, Paris (VIIIe).
BELGIUM.—W. H. Smith and Son, 78/80, Rue du Marché-aux-Herbes, Bruxelles, and 44, Rue Joseph II., Ostend.

SOUTH AMERICAN BRANCH OFFICE OF

The Engineer.

526, Bolsa de Comercio, Buenos Aires.

SUBSCRIPTIONS.

The Engineer can be had, by order, from any newsagent in town or country, at the various railway stations; or it can, if preferred, be supplied direct from this office.
Half-yearly (including index number) .. £1 12s. 6d.
Yearly (including two index numbers) .. £3 5s. 0d.
If credit occur, an extra charge of two shillings and sixpence per annum will be made.

Foreign Subscriptions will be received at the rates given below. Foreign subscribers paying in advance at these rates will receive The Engineer weekly and post free. Subscriptions sent by Post Office Order must be made payable to The Engineer and accompanied by letter of advice to the Publisher.

This Paper Copies.		Thick Paper Copies.	
Half-yearly	£1 11s. 6d.	Half-yearly	£1 13s. 6d.
Yearly	£3 3s. 0d.	Yearly	£3 7s. 6d.

(The difference to cover extra postage.)

Canadian Subscriptions—
Thin paper edition .. .. £2 18s. 6d. per annum.
Thick paper edition .. .. £3 3s. 0d. ,

*** Reading Cases, *to hold two copies of* The Engineer, *cloth sides and leather backs, can now be supplied at 4s. 0d. each, 5s. 3d. post free.*

ADVERTISEMENTS.

*** **The charge for Situations Open and Wanted Advertisements of four lines and under is four shillings, and one shilling per line for each additional line up to one inch. When an advertisement measures an inch or more, the charge is twelve shillings per inch The rates for all other classes of advertisements, other than those mentioned above, are included in "The Engineer Directory," which is sent post free on application. All single advertisements from the country must be accompanied by a remittance in payment. Alternate advertisements will be inserted with all practical regularity, but regularity cannot be guaranteed in any such case. All except weekly advertisements are taken subject to this condition.**

Small Advertisements cannot be inserted unless delivered before TWO o'clock on Thursday afternoon (the day before publication). ALTERATIONS to STANDING ADVERTISEMENTS must arrive not later than THURSDAY of the week preceding publication.

Letters relating to Advertisements and the Publishing Department of the Paper are to be addressed to the Manager, all other letters to be addressed to the Editor of The Engineer.

Postal Address, 33, Norfolk-street, Strand, W.C. 2.
Teleg. Address, "Engineer Newspaper, Estrand, London."
Telephone Nos. 2256, 2257 Central.

PUBLISHER'S NOTICES.

*** *If any Subscriber abroad should receive* The Engineer *in an imperfect or mutilated condition, he will oblige by giving prompt information of the fact to the Publisher, with the name of the Agent through whom the paper is obtained. Such inconvenience, if suffered, can be remedied by obtaining the paper direct from this office.*

TO CORRESPONDENTS.

*** *All letters intended for insertion in* The Engineer *or containing questions should be accompanied by the name and address of the writer, not necessarily for publication, but as a proof of good faith. No notice whatever can be taken of anonymous communications.*

*** *We cannot undertake to return drawings or manuscripts; we must therefore request correspondents to keep copies.*

By arrangement with Reuter's Engineering Service, **The Engineer** *contains the latest news from all parts of the world which is likely to be of interest to engineers.*

Contents.

The Engineer, August 25th, 1922.	PAGE
The Stability of the Sailing Ship. No. V. (Illus.)	183
The Kelham Beet Sugar Factory. No. II. (Illus.)	184
South African Electricity Bill	188
The South-Eastern and Chatham Railway's Electrification Scheme	188
Letters to the Editor—	
Indicating Opposed Piston Engines	188
The Late Dr. Gisbert Kapp	188
University Degrees and Engineering Appointments	188
A Seven-day Journal	189
The Sukkur Barrage. (Illus.)	190
French Summer Railway Services in 1922	191
Hulutao Harbour, Manchuria	192
Wreck Statistics for 1921	192
Railway Matters—Notes and Memoranda—Miscellanea	193
Leading Articles—	
Crystallisation	195
The Position of the Shipbuilding Industry	196
Brimstone *versus* Pyrites	196
Chinese Engineering Notes	196
Literature	197
Short Notices	197
Books Received	197
The Chlorination of Water	198
High Voltage Switchgear Developments. (Illus.)	198
A Suggested Solution of the London Traffic Problem. (Illus.)	200
Indian Engineering Notes	200
A Dynamic Balancing Machine	201
Visit of Young Engineers to South Wales	201
Peruvian Railway Contract	201
Cotton Culture in Australia	201
Forest Concessions in Bulgaria	201
Gas-driven Power Plant Using Wood Fuel. (Illus.)	202
Provincial Letters—	
The Midlands and Staffordshire	203
Lancashire	203
Sheffield	204
North of England	204
Scotland	205
Wales and Adjoining Counties	205
The Linear Electric Heating System	205
Current Prices for Metals and Fuels	206
French Engineering Notes	207
British Patent Specifications. (Illus.)	207
Forthcoming Engagements	208
Personal and Business Announcements	208
Educational Intelligence	208
Catalogues	208

THE ENGINEER.

AUGUST 25, 1922.

Crystallisation.

In spite of the progress of metallurgical knowledge and the wider spread which such knowledge is gradually receiving, one still hears frequent references to "crystallisation" of metals as a result of exposure to vibration or fatigue stresses and as a cause of ultimate failure. The origin of this entirely erroneous theory is not at all easy to trace, unless it be that the association of brittleness with a strikingly crystalline character lies at the base of the idea. Such substances as crystalline sugar, rock crystal and even metals like bismuth or antimony exhibit at one and the same time a strikingly crystalline character and extreme brittleness and in some cases extreme fragility. Again, it sometimes happens that the fracture of a piece of iron or steel which has been broken by repeated blows or fatigue stresses exhibits visible crystalline facets, while a piece of externally similar material broken by gradual means, such as a tensile test, shows a fibrous or "tough" fracture. Thus, the view may have arisen that a good, tough, "fibrous" metal becomes converted into a weak brittle material having a markedly crystalline character by some process of "crystallisation," which is brought about or favoured by vibration or alternating stresses. The wide acceptance which this view has obtained, and the difficulty which is still to some extent experienced in substituting for it a view more in accordance with known facts, is sufficient evidence of the plausibility of the older theory. None the less, closer examination at once serves to show that it is entirely untenable.

The first misconception which lies at the base of the old idea of "crystallisation" is that crystalline character and brittleness are inseparable. This is entirely untrue, and, indeed, is not only untrue, but the very opposite of the truth. We now know that all metals in their normal condition are crystalline, and that they owe their ductility or plasticity to their crystalline structure; so much so, that when, by such processes as cold working or quench hardening, we impair the perfection of the crystalline structure, we at the same time impair or destroy entirely their ductility. Pure lead is one of the most typically crystalline substances. This is, of course, in strong contrast with the typical brittleness of most mineral crystals, but it is now becoming clear that the brittleness of such substances is due, not to the fact that they are crystalline, but that the crystals are built up in a peculiar and complex way, arising from the fact that the substances are definite chemical compounds and not pure substances. Chemical compounds between metals are equally brittle in most cases, and the crystals of ordinary ductile metals owe their ductility to the fact that the atoms are arranged in a specially simple manner, which allows them to glide over each other in layers without becoming entirely detached. It is by interfering with this simple arrangement, as we do in severe cold working, that we destroy the ductility of the material. Now, setting aside the false assumption that crystalline character and brittleness are associated, we have to consider the different kinds of fracture which occur even in the same piece of metal under different conditions. Thus, a piece of good mild steel or wrought iron, if pulled out in a tensile testing machine, yields the well-known fibrous fracture. Here, again, one is liable to be misled by a false analogy. In a piece of wood or cloth there is a true fibre, and its nature is well displayed by the appearance of a tensile fracture. But here the component particles or cells are not themselves able to undergo much deformation during the pulling process. Consequently, the structure of the material does not become changed during any elongating process, and the fibre one sees in the fracture is the true fibre of the material. In a ductile metal it is quite otherwise. There is, in the true sense, no fibre in any piece of metal in its normal condition, unless the elongated patches of non-metallic impurity can be thus described. But, during the elongation period of a tensile test, or in the corresponding phase of a bending test, the structure is plastically elongated—the individual crystals and whole groups of crystals are drawn out into elongated bodies very like fibres. It is these elongated crystals which finally break across at the fracture, and show us the "silky" or "fibrous" fracture—the exact appearance depending upon the size and arrangement of the original crystals. If, however, the same piece of metal is broken in another manner, so as to avoid any considerable drawing out, a totally different fracture results. Thus, if a bar of wrought iron or very mild steel is deeply notched, it can be made to fracture under a single heavy blow. Here the crystals break across along their cleavage planes and are not drawn out into pseudo-fibres, with the result that we find a brightly facetted "crystalline" fracture. The material was equally "crystalline" in both cases, but the kind of fracture developed in these two different ways is widely different, and the crystalline character is much more obvious in one than in the other.

Finally, the old theory of "crystallisation" under vibration assumes that it is possible for metals like iron and steel to undergo internal rearrangement at the ordinary temperature. Actual observation shows clearly that this is not the case. Quite close to the fracture of a piece which has failed under fatigue or vibration the micro-structure is unchanged. It is true that the process of fatigue failure does bring about internal changes, but these are known to be changes occurring within the crystals of the metal, and not of the nature of any kind of crystalline re-arrangement. In the case of nearly pure iron, re-crystallisation does not occur at any temperatures below 500 deg. Cent., and even then only if the iron has been severely cold-worked. In softer metals, like gold, such changes can occur at rather lower temperatures, and in pure lead and tin they take place at the ordinary temperature of the air; but in all cases such changes render the metal softer and more ductile, not harder and more brittle. On every count, therefore, the old theory of "crystallisation" must be dismissed as untenable, and although the whole of the phenomena of fatigue failure are not yet elucidated, a better explanation is available. In the simplest terms this is that fatigue failure results from the fact that a stress which is unable to produce measurable permanent deformation when steadily applied, may yet be able to cause a slight amount of movement or slip in a few of the crystals of a piece of metal, and if this movement is repeated, or, worse still, reversed, many thousands of times, it brings about the disintegration of the material in its immediate vicinity. This, sooner or later, leads to further movement and subsequent disintegration in adjacent crystals, until a fracture is formed. Although at first sight less simple than the old theory, this view leads to many important practical conclusions. We can refer to only one of these. The old theory led engineers to adopt, as a precautionary measure, the practice of having parts exposed to vibration or alternating stress periodically "annealed," and this practice is still followed in a number of cases. The object was, of course, to undo the "crystallisation" which was supposed to have been taking place. What is its actual effect? Here everything will depend upon the exact conditions. If fatigue has progressed so far that even a few of the crystals have already become fractured, nothing can repair the damage,

and annealing is liable to do more harm than good. Also, if the part is strong enough not to undergo fatigue failure in continued use, then, again, annealing is likely to do harm. The reason here lies in the fact that unless an annealing operation is conducted with great care and knowledge, it tends to leave the metal with a lower elastic range than it had in the original condition, and such treatment inevitably tends to shorten rather than to lengthen the life of a part exposed to fatigue or vibration. An important example is the practice of annealing the cylinders used as containers for high-pressure gases — a practice which is certainly not consistent with modern metallurgical knowledge.

The Position of the Shipbuilding Industry.

It is a safe assertion that at no previous period within the memory of those now engaged in the home shipbuilding industry has depression been so acute or the outlook so dark as at the present time. The returns issued by Lloyd's Register of Shipping for each quarter have revealed a steady decline from the high-water mark touched two and a-half years ago, and to-day, not only has the tonnage nominally under construction fallen to an abnormally low level, but it is clearly foreshadowed that there will be a further decline before the bottom of the depression is reached. The quantity of shipping being put into the water shows a steady decline, the tonnage launched during the June quarter being less than 150,000 tons compared with 334,000 tons for the March quarter; but small as this total is, it exceeds the new work commenced during the same period. The result is that the number of empty berths tends to increase, and recent additions to the ranks of unemployed in the shipbuilding industry have been on an alarming scale. Many men who have been in regular work for many years are now being forced to join the ranks of the unemployed, and the outlook is certainly distressing. That this position should have been brought about in one of the most important industries of the country gives ground for serious reflection. It is true that, if the survey be extended to other countries, the position of the shipbuilding industry abroad is, in a majority of instances, found to be no better, and in some it is worse than is the case in this country. In the United States, where, until a comparatively recent period, such high hopes were entertained of the future of shipbuilding, the industry has almost ceased to exist. In Japan shipbuilding is in a state of stagnation, while in Europe, except perhaps in Germany, where the situation is by no means clear, the demand for new tonnage has shrunk to insignificant proportions. It can still be claimed for home yards, for what the claim is worth, that they contain the bulk of the world's shipping now in process of construction. It is quite obvious, however, that, except in the cases of motor ships, of vessels designed for the carriage of oil in bulk, and of a few ships of the liner class, the completion of this tonnage will be spread over a long period. The truth is, that owing to the state of affairs in the shipping industry, in which high costs of operation coincide with a period of unduly depressed trade, there is at the present time a plethora of tonnage for the purposes of sea transport. It will be said that many of the ships in service are old and comparatively inefficient if judged by modern standards, and it is reasonable to presume that, but for the high cost of acquiring new vessels, many of the existing ships would be replaced.

The problem which confronts the shipbuilding industry is, therefore, that of reducing construction costs to a point which even in face of trade depression will bring the shipowner into the new ship market. Any improvement in trade, of which the first signs are now held to be visible, would aid the campaign for the revival of the shipbuilding industry; but the task of the hour is to bring about such a reduction in constructional costs as will, when demand revives, make it certain that the orders will not be diverted to foreign yards. It is a comfortable assumption that British owners would not in any event go abroad for new ships; but it is possible that the pressure of economic conditions might justify even that course, and in any event it should not be overlooked that in normal times the activities of British yards are devoted to the extent of about 20 per cent. of the total output to filling the requirements of foreign owners. That custom will assuredly be lost unless there is a further drastic scaling down of building costs in British yards is evident. It need hardly be pointed out that in shipbuilding wages form a large percentage of the total costs, and it is a noteworthy feature, from that point of view, that arrangements have now been entered into for the withdrawal of the war bonus of 16s. 6d. per week. Whether this cut in the wages bill will meet the requirements of the situation is, however, doubtful; it is necessary that the industry should also experience the benefit of reductions of wages in other trades and of a consequent fall in the prices of shipbuilding materials. Ship construction makes a call on so many industries that a general fall in wages, and particularly throughout the engineering industries, should make a material difference in the prices which can be quoted to shipowners for new tonnage. Events are trending in this direction, and a gradual fall in the prices of shipbuilding material is to be expected. When that reduction has had time to make itself felt, and assuming that wages in the shipyards and associated marine engineering industry can be stabilised, the way should be clear for a moderate improvement in the situation.

There is a fear, however, that things may be worse before they are better. That fear has been somewhat allayed by the inquiries which have been received at some of the principal yards during the past few weeks, and by the placing of one or two orders on the North-East Coast and elsewhere. There is also the expectation that the contracts for the two new capital ships will be awarded in the near future and will ensure a certain amount of steady employment. Hopes are entertained, too, that the proved economy of the motor ship under service conditions will induce shipowners, even at the present level of prices, to add fresh units of this type to their fleets. Much more is required to be done, however, if a real beginning is to be made with the restoration of the home shipbuilding industry to its old-time prosperity. That, we repeat, can only be achieved by a resolute effort to get building costs down to a level which will make it a sounder financial policy for shipowners to acquire modern tonnage rather than to carry on with ships which are approaching the obsolete stage. Once the point is reached when capital outlay on new ships can be justified by the saving in operating costs, an upward movement in shipbuilding is assured. That point has not been reached to-day, and until it is, orders for shipbuilding yards will be almost entirely limited to ships which must be acquired for reasons in which price consideration have no weight.

Brimstone versus Pyrites.

A change of some significance and withal not without sinister import to certain mining interests is taking place at the present time in the heavy chemical industry. We refer to the substitution of sulphur for cupriferous pyrites in the manufacture of sulphuric acid. Of course, in the early days of the vitriol manufacture, brimstone from Sicily was the regular raw material, but during the last fifty years either ordinary pyrites or cupriferous pyrites has been the source of the great bulk of commercial vitriol, though a certain small amount of brimstone acid has always been made owing to its freedom from arsenic. The tendency of the moment, then, to revert to the use of sulphur is merely a throw-back, so to speak, and its permanence will depend on the persistence or non-persistence of certain economic facts. The most important of these facts is the price at which brimstone can or will be delivered in this country from America. The monopoly of Sicily as a sulphur producer was challenged some ten years ago by America, whose sulphur deposits in Texas were being worked by the Frasch process. This is quite distinct from the open mining and crude distillation carried on in Sicily, as the sulphur is brought up from deep deposits by the passing of steam down bore-holes. Up to recently this Texas sulphur has not had much effect upon the pyrites market, though, of course, the sulphur industry of Sicily has been seriously affected. It is the incidence of higher production costs in the pyrites mining industry, coupled with the slump in the price of copper, which has produced a situation that the Americans have been able to turn to advantage.

The United States used to be large importers of European cupriferous pyrites—that is, iron pyrites containing about 3 per cent. of copper—but now, we understand, this importation has practically ceased owing largely to the increased cost of the pyrites, and they are using their own sulphur. The ordinary routine for acid makers in this country—outside such large concerns as the United Alkali Company, owning its own pyrites mines—has been to buy the cupriferous pyrites at its quoted value for sulphur and copper contents and to sell the residual burnt ore or pyrites cinders to the metal extraction works. Here the copper, silver and gold are extracted by what is known as the Longmaid-Henderson wet process of roasting with common salt and precipitation of the copper as metal on scrap iron placed in the copper extraction liquids. The oxide of iron remaining was sold to the iron smelters. Such is a very brief outline of an important industry which at the moment is in a state of severe depression. Many of the works have been closed down for some time and others are only working very short time. The magnitude of the operations will be gathered from the Home Office Mineral Statistics for 1915, it being therein stated that 418,791 tons of burnt ore were treated at the metal extraction works, with an estimated yield of 15,077 tons copper, 1924 oz. gold, and 335,033 oz. silver. For the following four years it was stated that no statistics on this head were available, while the statistics for 1920 make no reference to the industry at all. That it continues in a depressed state is obvious from the fact that large stocks of cupreous burnt ore exist for which no market can be found, the copper content being a bar to its direct sale to iron smelters. This bar to direct sale does not, of course, apply to the burnt ore derived from ordinary non-cupreous iron pyrites, considerable amounts of which were imported during the war for reasons quite distinct from the points we are discussing here.

Of course, we are only mentioning a tendency and not a complete *volte face* in the change from pyrites to sulphur, so it is unnecessary to labour other effects, such as the withdrawal from the market of the 300,000 to 400,000 tons of burnt ore which have hitherto been available to the iron smelter. This is a small matter, however, compared with the interests that the various European pyrites mining companies have at stake. Will they take the new American competition placidly or will they recognise that immediate countermeasures are necessary for self-preservation? It is easy for erstwhile pyrites buyers to say that the mining companies have brought disaster upon themselves by inaugurating an era of high prices. Who has not been guilty of such conduct in the last few years? On the other hand, there is a general tendency to reduce prices when there is clear evidence that they are leading to disaster. The attitude of labour in such cases is, of course, all-important, and where the men are stubborn it is difficult, if not impossible, to work on lines dictated by common sense. One or two subsidiary considerations cannot rightly be ignored in the economics of the topic we are discussing, but the main factor is the price to the buyer per unit of available sulphur, and it now remains to be seen whether the gauntlet thrown down by America will be taken up in Europe. At the moment it is cheaper to buy American sulphur than European pyrites, and therefore it is being bought. The next word, therefore, lies with the pyrites producers.

Chinese Engineering Notes.

(*From our own Correspondents.*)

July 12th, 1922.

Peking.

The question of constructing a port at Hulutao, in the Gulf of Liaotung, has again assumed a new phase. For some years it has been the desire of General Chang Tso Lin to take this work in hand purely as a provincial scheme, but the Central Government always opposed it, on the grounds that such a port should come directly under the control of Peking. After protracted negotiations the Central Government arrived at an arrangement with the Provincial Government of Manchuria, under the terms of which the scheme was to be carried out jointly. The Central Government and the Government of Manchuria each agreed to contribute 500,000 Chinese dollars per annum for a period of five years for the carrying out of this work. Tenders were invited early this year and were to be closed in May; but several firms objected to this date on the grounds that the time was not sufficient to enable the scheme to be put before contractors in Europe and America. This date was finally extended to August of this year; but now the Central Government has come to the definite conclusion that it will be quite impossible to find the necessary 500,000 dollars per annum, so the work will not be proceeded with on the original lines. This does not mean that the whole scheme is to be dropped, but it is just a question of finance, and if British contractors can assist the Chinese Government in this direction it would not be a difficult matter to get favourable terms from the latter and the complete

co-operation of the Provincial Government of Manchuria.

In spite of acute financial difficulties, the present Government in Peking continues in being; but that is about all that can be said of it. General Chang Tso Lin still controls the three Eastern Provinces, and is likely to continue to do so. His relations with the Central Government seem to be quite friendly, and General Wu Pei Fu, who defeated him in the field, has withdrawn practically all his troops to his headquarters in Honan and does not appear to be interested in the future activities of General Chang. Further trouble is expected in Central China, particularly in the Province of Szechwan, where local fighting has already taken place on a small scale. Latterly there has been every indication of a settlement between Peking and the Canton Government, and if this be brought about the possibility of serious trouble in Central China will disappear automatically. In the meantime there are two types of foreigners—by foreigners we mean all nationals other than Chinese—in Peking. One is the enviable person who has not taken an order from the Chinese Government during the last two years, and who is told by his principals not to do so until there is a chance of getting paid for his goods, and the other is the poor fellow who fell into the trap and booked orders *ad lib.* and is now whistling for his money. As a matter of fact, in the second category Americans predominate, and very few British firms have found themselves in this position.

There is a scheme on foot for the establishment of a waterworks for Kaifengfu, the capital of the Province of Honan. Some Chinese capitalists have subscribed about £80,000, which, it is estimated, will be sufficient to start the project. Waterworks would pay very handsomely in China were it not for the difficulty in collecting the revenue. As it is, those already in existence pay well, but nothing like the percentage that would be possible if "leakage" could be stopped. In the average Chinese city the houses are so small and people so poor that it would not pay to put in meters, so the system generally adopted is to have stand-pipes in the street with a coolie in charge. The householders send for their water to these stand-pipes and are supposed to pay for it by means of tickets or checks which the waterworks company sell. The coolie in charge, however, much prefers hard cash and will allow a big discount for this system of payment. Needless to say, very little of this cash ever reaches the shareholders of the waterworks company.

Shanghai.

It being established to our satisfaction that there is need for capital to be invested in this country, it remains to be seen how it will be done, as there is ample evidence of capital being available for this purpose. In the history of the development of a country like China there are factors uncommon to the development of other countries. Whereas in other undeveloped countries you have natives who are unversed in the modern science of commercialism, the conditions here are that in all probability commercialism has largely been acquired from Eastern races, such as the Chinese, who had been adepts at it hundreds of years before our ancestors abandoned the barter and club system—metallic money was used in China twenty-two centuries before the Christian era. This being so, it is evident that we foreigners must disabuse our minds of the idea that in making an investment in this country we can have it all our own way, and we must accept the conditions that, in order to benefit ourselves, we must more largely benefit the Chinese or be prepared to be told that our help is not needed, and it is no doubt largely this attitude of the Chinese which has led to the establishment of native banks doing business direct with London and New York and other large capitals. The Chinese were content to do business through foreigners so long as the foreigners were "showing them how," but with the accumulation of commercial wealth, aided by Western educated Chinese, the situation is changed, and the Chinese have learnt that our imposing banking establishments are merely substantial evidences of their own idea of centuries ago. The Chinese now want to be partners rather than *compradores* on the commission basis. And as the country has something very valuable to offer in the way of trade, and knows it, there is some justification for the Chinese attitude; but there is still the drawback of lack of political union in the way of a greater expansion of trade by the Chinese themselves, and in order to overcome this handicap they are willing to bring in the firm hand of the foreigner, who is prepared to insist upon the protection of his interests and those of his partners. This explains why there is a growing tendency towards combinations of Chinese and British, as we have a stable Government which, whilst it is the last to interfere in the details of any individual Briton's business so long as he conforms to the law of his own country and that of the country in which he works, still the fact that he has stable conditions in his homeland gives the Chinese confidence. Added to this there is, of course, the knowledge held by the Chinese that, although the British are sometimes slow, they are sure, and will not offer something which they are not in a position to supply. It is true that the Chinese want financial help, but they want moral help more. It is only when they are the under dog that the Chinese are likely to turn upon the foreigner, and it would largely increase the safety of existing foreign trade in this country to encourage financially its industrial development. In fact, it may be accepted as an axiom that international trade and therefore financial help secures international peace.

Hong Kong.

Turbines Built in Hong Kong.—A few days ago the writer had the privilege of attending the trials of the ss. Kaying, which has been built and engined by the local works of the Taikoo Dockyard and Engineering Company, Limited, of Hong Kong. This vessel is remarkable, neither on account of its size, nor because of any new design. She is in appearance just one of the many vessels belonging to the China Navigation Company, Limited, the fleet of steamers of which are to be found all over the Far East. What makes the Kaying worthy of notice is the fact that her turbines were built in Hong Kong. It is a significant fact that it was only the expected that took place when the locally made turbines successfully propelled the ship through her trials. These marine turbines are the first that have been entirely manufactured in any shipbuilding yard in China. It is probably true to say that they are the first steam turbines to be built in any part of Asia other than Japan. The building of these steam turbines necessitated that a considerable amount of new plant, such as machine tools, should be sent out to the Taikoo Dockyard from Great Britain. It cannot be supposed that all of this new equipment has been sent out here for the purpose of building just one set of steam turbines, and no doubt other similar work will be taken in hand. Just at present the local shipyards would welcome orders for new vessels.

"What I heard first I heard last; the one thing the English value is *pluck*." That remark was made by a very great American, and it was quoted during the complimentary speeches made when the trials of the ss. Kaying were completed. It was indeed very plucky of the celebrated Taikoo firm to undertake the building of this new type of machinery when it had at its disposal only native labour. A word of praise is due to the British supervising staff in this connection. The local Chinese mechanic is probably second to none in the world in handling a job of which he has had past experience. In the building of reciprocating engines local Chinese mechanics have had plenty of experience. Before they built reciprocating engines they had years of practice on repair work. They have as yet had no experience at all in connection with the repairs of turbine machinery. It is therefore worthy of comment that under British supervision these turbines were successfully manufactured by Chinese mechanics. That fact should cause firms in Great Britain considerable thought.

During the trial of the Kaying there were present representatives of the American Shipping Board and other local dockyards. There was also a representative from one of the shipbuilding yards in Shanghai. These men were very much impressed by the engineering work done here. If the Kaying should prove as successful in practice as she has during her trials there can be no doubt that geared turbines will become popular in the Tropics. This ship is destined to run between Hong Kong and Bangkok. With the older type of machinery the engineers on similar ships had a trying time on the run. Some of them have informed the writer that the engine-room temperature in Bangkok was often as high as 135 deg. Fah. In a small engine-room and with reciprocating machinery that must have been unpleasant. The contrast of the engine-room during this trial and that of the engine-room of an ordinary China Coast steamer made one realise that the new era of applied science has reached China. The sight of an elderly Scotch engineer, "an old China hand," who for years had put his faith in the spanner and oil can, and who, during these trials, was anxiously recording temperatures, &c., in his notebook, was amusing, if only because of the puzzled expression on his face. That the machinery was mysterious to him was obvious. Yet marine engineering in China will now require him to extend his knowledge of machinery much more in the future than in the past if he is to hold his job. That will be all to the good.

It will be of interest to obtain practical working figures as to the maintenance of vacuum on these vessels. There was no attempt at exact measurement of steam consumption during the trials, and the local difficulty concerning coal is that there is considerable variety in the quality of the coal available. Thus it is difficult to make comparisons with ships of the same class until the new vessel has been on the scheduled run for some time. The owners have a well-deserved reputation for economy of running expenses in their ships.

It is a pity that there is no arrangement for popular lectures on new development in engineering science. There are those that believe that ultimately the internal combustion engined ships, such as the ss. Selandia, running to this port, will beat reciprocating machinery and steam turbines. It is true that we are not far away from the oilfields of the Dutch East Indies. It is also true that oil fuel is being used on some of the steamers running to the port. If only one could obtain coal from the neighbouring Chinese Province of Kwangtung, where it lies in abundance, the steamers would be run at much less cost. We do not despair, despite many recent disappointments. For some years Hong Kong has been amongst the three largest ports in the world, and has indeed headed the list. There is always a great deal of ship-repairing work being done here. During the war the local dockyards were very busy on shipbuilding, and some splendid vessels have been built in the Colony during the last seven or eight years. When the demand for ships is again insistent the local yards will be ready and well equipped.

Literature.

SHORT NOTICES.

Electrical Engineering Testing. By B. G. D. Aspinal Parr. Price 16s. London: Chapman and Hall, Limited.—The fourth edition of this book differs from its predecessors in that its scope is much wider, and many tests which were not dealt with previously are now described. The inclusion of these additional tests brings the direct-current portion of the book more thoroughly up to date. The greater proportion of the new tests, however, are alternating-current tests, which are supplemented by additional matter dealing with modern theory. In its present form the volume should, we think, prove useful, not only to students, but to a good many engineers who occasionally have to make tests on electrical machinery, transformers, cables, and so forth. A fact which we should not omit to mention is that the greater portion of the book has been completely rearranged, so as to bring all the tests of a like nature together.

Automatic Pumping. By W. W. Fyfe. London: Charles Griffin and Co. 1922. 7s. 6d. net.—A quaint little volume on a fascinating subject. The action of the water ram has given cause for numbers of statements, as to its capacities and particulars, in various text books, and none of these agree very well. The author attacks all these theories and endeavours to put forward rules for proportioning rams. Unfortunately, his manner of writing rather obscures the lesson, and this is disappointing, as he evidently has had considerable experience on the subject. There is, nevertheless, a considerable fund of information in the volume, and the author makes a number of valuable suggestions.

Alternating-current Electrical Engineering. By Philip Kemp, M.Sc. London: Macmillan and Co., Limited. Price 17s.—The second edition of this book, which was originally published in 1918, differs from the first edition mainly in that it contains a new chapter on the protection of alternating-current systems and a number of alterations in the chapters on electrical instruments. In its present form the volume is well up to date and appears to fulfil the requirements of students who have already mastered the elementary branches of electrical engineering. As the title implies, the book is devoted entirely to alternating-current work.

Elementary Hydraulics. By F. C. Lea. London: Edward Arnold and Co. 1922. 7s. 6d. net.—This book is primarily intended for the use of students at technical schools—the author is professor of civil engineering at Birmingham University—and deals with the subject in a lucid manner. It cannot be expected, of course, that hydraulics could be covered exhaustively in a couple of hundred pages, but the information given is to the point and should carry the student a long way in his studies. The illustrations are plainly drawn and there are typical questions, with answers, for each chapter.

Steam Power Plant Auxiliaries and Accessories. Edited by T. Croft. New York: The McGraw-Hill Book Company. 1922. 15s.—This volume is really a selection of little sketches, both pictorial and verbal, of the principal items which go to make up the auxiliary equipment of a steam power plant. Brief descriptions of the various machines in common use in America are given, together with hints on their installation and maintenance. The relative merits of alternative arrangements are discussed. The illustrations are all well executed.

BOOKS RECEIVED.

Institution of Civil Engineers: List of Members. Addresses corrected to July 1st, 1922.

Gloucestershire Council: Thirty-third Annual Report of the Highways, Works and General Purposes Committee.

Report of British Empire Patent Conference, 1922. London: His Majesty's Stationery Office. Price 1s. 1d., post free.

Tolley's Income Tax Tables, 1920–22 *and* 1922–23. By Charles H. Tolley. London: Waterlow and Sons. Price 1s. 6d. net, post free 1s. 7d.

The Czecho-Slovak Republic. By Jaroslav Cèsar and F. Pokorny. London: T. Fisher Unwin, Limited, Adelphi-terrace, W.C. 2. Price 9s. net.

South Wales and Monmouthshire School of Mines Calendar. Session 1922–23. Cardiff: South Wales Printing and Publishing Company, Limited, Mill-lane.

Income Tax and Super-Tax, 1842–1923. Fifth edition. London: Oliver and Boyd, 33, Paternoster-row, E.C. (Edinburgh, Tweeddale-court). Price 1s. net, by post 1s. 2d.

University College of South Wales and Monmouthshire, in Association with the South Wales and Monmouthshire School of Mines: Regulations and Scheme of Study, Session 1922–23.

Chart of Rates, Allowances and Abatements for Income Tax, Excess Profits Duty, &c. By Charles H. Tolley. London: Waterlow and Sons, Limited. Price 2s. 6d. net, post free 2s. 8d.

The Chlorination of Water.

The sixteenth annual Report on the Results of the Chemical and Bacteriological Examination of the London Waters, by Sir Alexander Houston, the Director of Water Examination to the Metropolitan Water Board, has recently been published. We have frequently in the past had occasion to remark on the useful character of the matter contained in these annual publications of Sir Alexander, and the present example is typical of those that have preceded it. It abounds in valuable data, and it would be hopeless in a survey of it, such as the present article, to draw attention to all the matters discussed or to all the subjects on which light is thrown. We have decided, therefore, to confine our remarks to the question of the chlorination of water, concerning which a great deal is said, as was the case with the last Report.

Sir Alexander remarks that the calendar year 1921 has probably had no parallel within living memory or within the reach of reliable records, so far as deficiency of rainfall in the South-East of England is concerned. It was, he adds, a momentous year in the history of many water undertakings, and the advocates of the need for some form of central control of watershed areas have gained many adherents as a result of the conditions which prevailed during it. Among other questions which arose was the practicability of utilising for domestic purposes supplies of water which are known to be impure. "Under scientific guidance and control," remarks Sir Alexander, "great liberties can be taken in the direction of rendering impure sources of supply safe for domestic consumption, although this is not a policy to be recommended unless the circumstances demand it, and expedients justifiable now may require consideration when the country becomes prosperous again." Expedients of the kind were, in fact, resorted to in connection with London water, with perfect success both as regards purity of the water as supplied to consumers and as concerns the saving of money.

Chlorination was first applied to London water as a war measure and as a means of conserving coal and saving money. It was successful in both. By its use it was found possible to avoid the expense of pumping large quantities of water into reservoirs for storage and partial purification, the raw river water being, instead, treated with chlorine in some form or other. Since May, 1916, about 2,000,000 people have been practically continuously supplied with chlorinated Thames water of excellent quality and without a single complaint as regards taste having been received. During the twelve months under review 24,569,600,000 gallons of raw Thames water obtained from the intake at Bell Weir were treated with an expenditure of 135.13 tons of chloride of lime—bleach—the cost of which was just over £2207. Had all the water thus treated been pumped into the Staines reservoirs, the cost of the necessary coal would have been just over £23,341, so that the net saving was £21,134. The average "dose" of chemical in terms of available chlorine was 1 in 2.41 million gallons of water; that is to say, that 12.32 lb. of bleach were used for each million gallons at a cost for chemical alone of 1s. 9.6d. The quantity treated was 90.66 per cent. of the total volume supplied, the difference being made up with reservoir water when the river was in too turbid a condition for the abstraction of water. As regards quality, Sir Alexander adduces figures which show that, whereas storage improves raw Thames water bacteriologically 100 times, chlorination "succeeds considerably better than storage on the *average* and is *nearly seven times superior* during the *winter* months, when both the river and the stored water give the *least satisfactory* results." Chemically, it is remarked that the results obtained after filtration compare favourably with the average for the ten years prior to the application of chlorine—that is to say, while storage and slow sand filtration alone were employed—especially as regards albuminoid nitrogen and oxygen absorbed from permanganate. The figures on which that statement is founded are as follows:—

Chemical Results, Expressed in Parts per 100,000.

Filtered waters.		Ammoniacal nitrogen.	Albuminoid nitrogen.	Oxygen absorbed from permanganate—3 hours at 80 deg. Fah.
East London (Sunbury)	1906–16	.0003	.0055	.0737
	1921–22	.0007	.0054	.065
Kempton Park	1906–16	.0006	.0076	.0940
	1921–22	.0013	.0059	.076
West Middlesex	1906–16	.0005	.0060	.0852
	1921–22	.0005	.0051	.062
Grand Junc. (Hampton)	1906–16	.0003	.0056	.0749
	1921–22	.0003	.0049	.059
Grand Junc. (Kew)	1906–16	.0003	.0056	.0758
	1921–22	.0004	.0052	.058

In addition to these results, chlorination brings about a considerable percentage reduction in the acreage of filter beds which have to be cleaned within a given period, and though it does not prevent the development of algal and other vegetable growths in reservoirs it would seem to have a retarding influence.

Sir Alexander also gives some figures showing the results obtained with chlorination on water abstracted from the river as far down as Surbiton. The filters at the Chelsea works of the Board are usually supplied with stored water of admirable quality from the Chelsea storage reservoirs, which are, in turn, fed with raw river water taken at Walton. Last year's drought became so acute that it proved to be a matter of great importance to the Thames Conservancy and to the Water Board to conserve water in the upper reaches of the river. There is an old intake at Surbiton, 5½ miles below the Walton intake. It had remained disused for a lengthened period, but it was decided to re-open it temporarily, to filter the raw river water thus obtained, and to correct any imperfections in the filtered water product by means of chlorine with an emergency permanganate plant in addition, to cover questions of taste. This decision was not lightly arrived at, as not only was raw river, instead of stored, water to be used for filtration purposes, but the polluted river Mole enters the Thames between the Walton and Surbiton intakes, and there are, doubtless, other sources of undesirable contamination. It was felt, nevertheless, that if the sterilisation process were kept under perfect control any desired bacteriological result could be obtained and that no real danger to health was involved in the experiment. As a matter of fact, the experiment was entirely successful. It was continued for a total of 191 days, during which 14 million gallons a day were abstracted and 9380 lb. of chlorine, with a total cost of £156 6s. 8d., were used, the "dose" varying from 1 in 1.5 million on the first day to 1 in 2.5 at the end of a fortnight, and finally, after one other reduction, to 1 in 4.0 for the last three months or so. Permanganate was only used when any doubt arose as to possible taste, and it was probably used sometimes as an extra precautionary measure when in point of fact it could have been dispensed with. The amount of the "dose" was always 2 lb. per million gallons, and during the seventy-four days that it was employed 1904 lb. were used, the cost being, at 1s. 6d. per pound, £142 16s. The total cost of treatment, therefore, amounted to £299 2s. 8d., or 2s. 2.8d. per million gallons, and if the price of labour be included, about 3s. per million, against which had to be set the saving in coal through not having to pump the water into the Chelsea reservoirs, the amount of which is not stated in the Report. The bacterial results are described as being "practically perfect," the percentage number of samples containing no *B. coli* even in 100 c.c. being 100. As regards the filtered and chlorinated water, the chemical results, excepting the ammoniacal nitrogen, chlorine and colour tests, were better than the average during 1906–16. The oxygen absorbed from permanganate figure was 0.051, as compared with a normal average of 0.089, and was, as Sir Alexander says, "remarkably low, no doubt due, to a considerable extent, to the permanganate treatment." Hardly any complaints as regards taste were received, and, taking the whole period, it may be said that, practically speaking, the consumers—and there were 300,000 of them drinking the water for six months and more—received a tasteless water throughout the experiment. These results, Sir Alexander adds, "showed conclusively that a worse water—raw river water compared with stored water—can be changed actually into a better finished product—considered bacteriologically—by the means of purification adopted and at a less cost. Inferentially it may be concluded that an equally good final result could have been obtained if a better water—stored water compared with raw river water—had been filtered at a higher speed than is normal. That is, if it is safe to assume that such a procedure would not give rise to any mechanical or engineering troubles."

In the case of the New River the critical months are, normally, November, December and January, for it is then that floods occur, and "these floods, owing to inadequate storage capacity and too rapid filtration (in a relative sense), produce marked deterioration in the filtered water results." The trouble is often enhanced by the advent of bitterly cold weather. Severe frost not only interferes with the filtration arrangements, but owing to taps being left running all night and to burst pipes, it leads to greatly increased rates of filtration. It is possible also that the comparative absence of algal and other growths in the river water during these months renders the filters more permeable to the passage of microbes, owing to the relative absence of a protective skin on the surface of the sand. The result in the past was that some bad readings as regards *B. coli* were the rule during these three winter months, as the following figures clearly show:—

Table Showing Percentage Number of New River Filtered Water Samples Containing B. Coli.

	+ 100 c.c. (or less).	+ 10 c.c. (or less).	+ 1 c.c. (or less).
Nine months (average Feb., 1906, to Oct., 1915) ..	Per cent. 11.0	Per cent. 1.5	Per cent. 0.1
Three months (average Nov., 1906, to Jan., 1916) ..	38.9	11.8	1.3

The application of chlorination had the effect of wiping out these relatively unsatisfactory results during the months in question, and the necessity of constructing enormously expensive remedial works was avoided. Taste troubles, which were at first experienced, were overcome by the use of potassium permanganate and by the installation of a sulphurous acid (SO_2) de-chlorination plant, which, however, is only used when the dose of chlorine is at a maximum and when the water is exceptionally cold.

When discussing the future of chlorination Sir Alexander makes the following remarks regarding the objections raised by some to the use of this method of water sterilisation:—

"Many persons object most strongly to drinking what they call a 'doped' water, and consider that the use of chemicals for purification purposes is worse than playing with black magic. Logically, these people should drink only deep well water and water from virgin moorland or upland sources of supply. Obviously, a river draining populated areas, and therefore exposed to sewage pollution, is inadmissible in their case, for, apart from trade wastes, the amount and variety of chemicals poured down house drains and ultimately reaching our rivers gives food for thought. Truly, it is not the nature and amount of these chemicals which matters so much as their ultimate combinations. Many pass into a practically insoluble state; others, originally harmful, are rendered inert by combining with other substances. For example, both caustic soda and sulphuric acid are irritant poisons, but combined in suitable proportions they yield sodium sulphate (Glauber's salt), a mild aperient, liver stimulant and anti-rheumatic remedy, taken daily throughout most of their lives by a very large number of people. The writer is far from flouting sentimental considerations, but if rivers are to be used as sources of water supply, we must look rather to the innocuous character of the 'finished product' than to its antecedents. There is absolutely no convincing evidence that a properly chlorinated water is in any way injurious to health."

High Voltage Switchgear Developments.

By W. A. COATES, M.I.E.E., Mem. A.I.E.E.

Many years ago American engineers were in the fortunate position of being able to see and profit by the mistakes which we had made before they were deeply committed, themselves, in the matter of electricty supply standards. The result is to be seen in their almost complete uniformity of system, frequency and pressures, as compared with our numberless variations under these headings.

To-day the tables are turned, and we, who are just facing the problems of high-voltage transmission, are able to take advantage of the previous experience of American and European engineers in this direction. It should be noted that the phrase "high voltage" is used here in reference to super-generating pressures.

In the nature of things, the majority of the high voltage switching equipments in the world have been designed by American engineers. Many of their hydro-electric developments would only have been possible if planned along the most economical lines, and the keynote of their switchgear is simplicity. On the other hand, the European developments appear to have been confined largely to those sources of power which did not demand great expenditure on hydraulic work, so that the electrical side could be treated more generously.

The high voltage switchgear in continental plants has, so far, been placed indoors, and accommodated in cubicles of moulded stone or similar materials, along lines very similar to the construction familiar in our own plants for 6600 or 11,000 volts. Ample gangways are provided between the gear for different circuits, and, on occasion, separate fireproof rooms are employed for the apparatus on each circuit. Even in the earliest American high-voltage switching equipments cubicle work was dispensed with. A single large room was provided for the switchgear, the apparatus either standing on the floor or being supported from a light pipe work structure. Although such arrangements were inexpensive, the designers later went one further, and placed all their step-up transformers and high voltage switchgear outside. This sounds like inviting trouble, although a brief consideration shows that the conductors for high-voltage transmission are also out of doors and really present more points for insulation failure than the terminal station apparatus. Practically there is no more trouble on these outdoor switching plants than there is with indoor gear. In the last ten or twelve years the majority of new installations have been erected out of doors, and it is noteworthy that isolated equipments of this character have lately been erected in France, Switzerland, Italy, Spain, Norway, and Holland. This, despite the official ban of the V.D.E., which disapproves of outdoor switchgear above 30,000 volts.

The whole secret of success lies in employing apparatus which is designed to meet the special conditions of service which are imposed. Apparatus based on designs which have been in successful operation in America for the past decade, and embodying their most modern features, is now being built in Manchester by the Metropolitan-Vickers Electrical Company.

The most important and interesting item is the oil circuit breaker, and here a word of explanation

is desirable. Even with indoor apparatus it is not possible to keep switch oil quite free from moisture. A perfectly dry oil, exposed to our indoor atmosphere for twenty-four hours or so will take up from it sufficient water materially to lower its dielectric strength. A week's exposure will carry this absorption to the limit, and even if the oil be shaken up with added water, the latter will quickly settle out and leave the oil with the original lowered insulating value. Oil, in fact, is actively hygroscopic to a limited

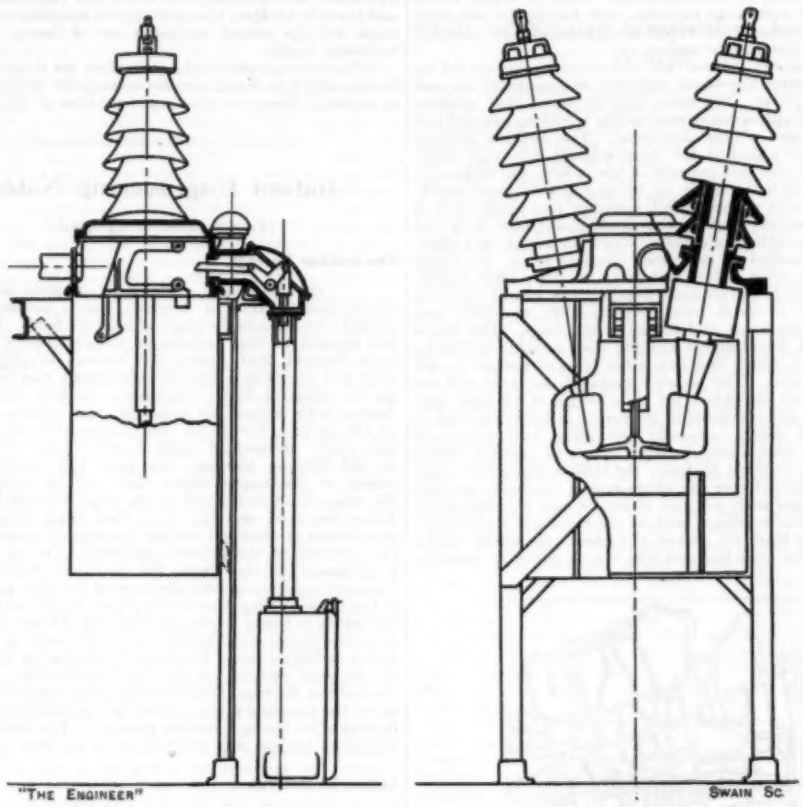


FIG. 1—ARRANGEMENT OF OUTDOOR OIL SWITCH

degree and all apparatus, either indoor or outdoor, has to be designed with clearances adjusted to the use of oil which has water in solution. Admittedly, better operation or a higher factor of safety would be secured if the oil could be kept dry, and since in the case of transformers this question is important, calcium chloride breathers or conservator tanks are sometimes fitted. In oil switches arc-quenching requirements, rather than insulation, control the quantity and position of oil. It is only necessary, therefore, to keep water, as such, out of the tanks, and not to attempt hermetical sealing.

In the series of switches included in the Metropolitan-Vickers apparatus, first mentioned, all the tank and cover joints are packed and provided with overhanging lips. To allow for operating conditions, however, each pole of the switch has a gas vent in the cover, so designed as to prevent oil throwing and the ingress of wind-driven rain, while permitting free escape for the gaseous products of arcing. As is usual with properly designed switches, these vents discharge the gases on one side, well away from the live contacts.

A feature of the greatest importance on outdoor oil switches is the provision of facilities for adjustment and repair. Usually such work has to be done in position, maybe in bad weather, or by workers whose hands are cold and stiff. Up to 73,000 volts, the switches are mounted up on a rolled steel frame permitting the tanks to be lowered by means of a portable winch—Fig. 1. This gives free access to the contacts, corona shields and arc shields, which are usually the only points requiring attention. Normally the tanks are retained in position by hanger bolts which support angle braces under the bottom. Should any part of the parallel link gear require adjustment, it is accessible through a handhole in the cover. Here the toggles can be set for either automatic or non-automatic operation and the tie rods between poles adjusted for length. As a point of manufacturing convenience it will be noted that the whole link work is carried on a unit frame casting bolted on the underside of the cast steel top, and removable in one piece.

Larger switches require so much oil as to make the suspended tank construction undesirable. In such cases the tanks stand on the floor, being supported clear by a steel ring in which are holes to facilitate painting underneath. The handhole in the cast steel top gives place to a manhole, since the tank is large enough to permit a man to stand inside and work at ease. Permanent oil piping systems for filling and emptying these large switches are usually installed.

The leading in terminals are always the most vulnerable points in high-voltage apparatus. The well-tried condenser type has been adopted on account of its practical and technical advantages, and despite the fact that other forms are distinctly lower in first cost. As its name implies, this terminal consists of a number of concentric condensers built up solidly around the central conductor. The capacities of the adjacent layers are adjusted so as to obtain a uniform voltage gradient both through the thickness of insulation and over its length. The former gives a terminal of minimum diameter, since the dielectric between each pair of metal inserts is thin and can be worked to best advantage. The cheaper solid and semi-solid insulators are anything from 50 to 200 per cent. greater in diameter. A small diameter permits ring type series transformers to be mounted over the middle earthed portion of the terminal, and these have such good ratio characteristics that ammeters or relays may be satisfactorily operated from them.

The uniform gradient over the length of the terminal gives a higher final flash-over value, which is reached with practically no previous corona discharge. Since the outer surface of the condenser itself is necessarily smooth, porcelain rainsheds to break the continuity of water flow are fitted for outdoor working. These sheds are cemented one within the other, flexible seatings being used in the spigots, and the space between the tube thus formed, and the terminal proper being filled in with a special bitumen compound.

As a rule all the oil switches are operated electrically from a central point, which, in sub-stations, is commonly in the house of a resident engineer, where a motor generator set and storage battery are installed. Gear for the lower pressures, say up to 50,000 volts, is sufficiently light to be regularly operated by hand, and this form of control may in such cases be preferred for isolated sub-stations. Whatever the normal method of control, however, all switches are provided with a removable lever by which they can be closed slowly by hand for the purpose of adjusting contacts.

Controversy on the matter of lightning protection still persists. The fact is that a perfect lightning arrester, which will relieve the system of repeated direct strokes, does not exist. The nearest approach to perfection is undoubtedly the electrolytic type, which, when fitted with Mr. C. T. Allcutt's impulse gap, can be relied upon to deal satisfactorily with all but the most severe direct strokes. The oil insulation around the aluminum trays gives great thermal capacity, so that during a storm the arrester may be discharging almost continously for some hours without damage. Where storm conditions do not warrant much capital expenditure, resort can be had to the cheaper forms, such as the multiple, shunted gap type, and the simple horn arrester, which have a much lower discharge rate, and, like an electrolytic without the impulse gap, are insensitive to periodicity of discharge. This type and the multiple gap arrester both commence to discharge on about the same voltage rise—something of the order of 130 to 160 per cent. of normal system pressure—while the horn type is more usually set to arc-over at from 160 to 200 per cent. of normal. The multiple gap arrester, which is sometimes termed the Wurts type, has been built in this country for many years and is well known in indoor installations. For the majority of our installations it probably represents the desirable mean in the matter of cost and degree of protection afforded. It does not, however, lend itself to outdoor mounting. There is no technical limitation to the system pressure on which Wurts arresters may be used. Very roughly, it may be said that their cost and size increase directly with the voltage, so that with increasing voltage of distribution the advantages of the horn type became more apparent. On very high pressures, the choice lies directly between horn arresters, electrolytic arresters or no arresters at all.

In Scandinavia and some parts of America lines of 80 kilovolt-ampères capacity and over are in operation without any lightning protective apparatus. The amplitude of induced disturbances on a transmission line is quite independent of the system voltage, and since the factor of safety employed in insulators is practically constant, it stands to reason that many induced surges, which would cause a flash-over on the insulation of a moderate voltage line, will be quite harmless on a line built for a higher transmission voltage.

A form of horn arrester very widely used in America on lines up to about 66 kilovolt-ampères is shown in Fig. 2. This also is now being built in England by the Metropolitan-Vickers Electrical Company, Limited. It will be seen that by an ingenious arrangement the choking coil is so shaped as to form part of the main discharge horn. The coil is so wound as to cause the load current to establish a magnetic

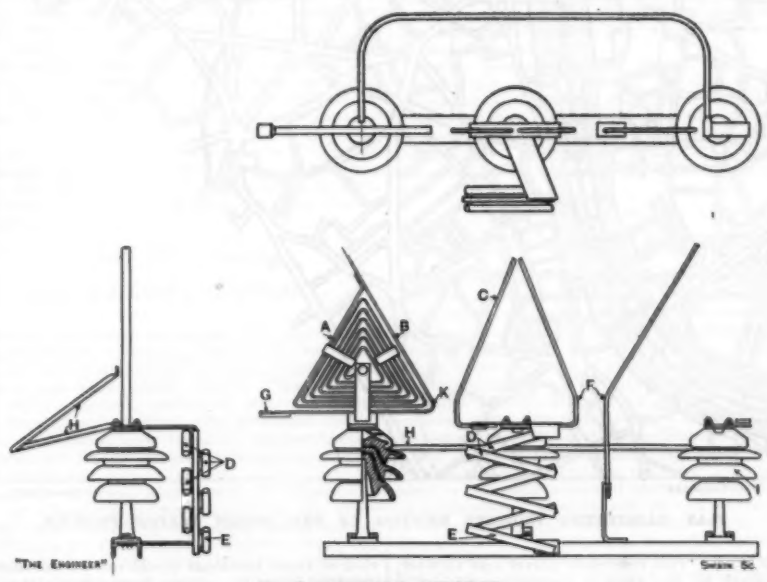


FIG. 2—LIGHTNING ARRESTER

field tending to force the arc up the horns, and thus to extinguish it more quickly. A compound resistance is in series between the main horn and earth. This resistance is shunted by a small auxiliary gap, which is bridged by high frequency, high voltage surges in much the same way as in the Wurts arrester.

It will be noticed in Fig. 2 that the choking coil A is incorporated in the structure of the arrester itself, one side B of the triangle forming also one element in the main horn of the arrester The opposite horn C is arranged in series with an earthing resistance composed of several composition rods D similar in appearance to carborundum. The bottom rod, E is directly connected to the earthed steel frame

on which the complete arrester is mounted. In addition to this main circuit to earth, there is provided an alternative path across the horn gap F, but in this case the earth horn is mounted directly on the steel work without any resistance in circuit.

The device is connected in such a manner that the transmission line enters the triangular choking coil at the point G, and having traversed the turns to the centre, a connection H is taken to the terminal insulator I and thence to the transformer or other apparatus protected. In operation any impulse coming from the line enters at G and meeting its first impedance at the upward turn K, opposite to the main gap, the voltage tends to build up at this point, and cause a spill-over to the ground horn. A very high frequency discharge will prefer to take the lower resistance path through both main gap K and auxiliary gap F, while at lower frequencies the path selected would be through the main gap K and resistances D, the latter then operating to limit the possible flow of dynamic current. Even when the switchgear proper is placed indoors, horn arresters of this type may advantageously be placed outside to protect overhead feeders. From a protective standpoint such an arrangement is ideal, since the arrester is connected in before all the switching apparatus and supporting insulators.

A Suggested Solution of the London Traffic Problem.

We reproduce herewith a drawing which has been sent to us by Messrs. F. Rings and T. C. Hood, in illustration of a scheme which they suggest would provide a solution of the London traffic problem. Accompanying the drawing were the following explanatory details:—

"There is no necessity to prove the existence of the overcrowding of our thoroughfares, and particularly at the bridge heads. One need only travel east to west, or south to north by any kind of conveyance to realise that in many cases it would take less time to return to the methods of our ancestors and walk. Who has not felt irritation caused by being held up, not minutes, but often many minutes, every few hundred yards, and if one could calculate the time wasted, the cost of petrol wasted, and the consequent loss to every kind of business, the result would be astounding. A superficial glance at a map of London at once shows the reason. All side streets lead into main thoroughfares, and these are gathered into main points and eventually concentrated on a few bridges across the Thames.

"It will be readily admitted that of late years a tremendous amount of traffic dealt with in former years by the railways is now thrown on the roads, and it will be just as easily realised that with the advent of motor traction, the road traffic is bound to increase considerably, and eventually become such a hopeless problem unless dealt with now, on lines which will admit of a universal spreading of traffic. We build bridges at high cost, only to realise when they have been in existence a short time, that they are hopelessly inadequate; then we widen them at great expense, or possibly add another bridge, but all these methods cannot in the end solve the difficulty, which is purely due to the concentration of traffic at the bridge heads.

"This has been realised for many years past, and hence the suggestion to divert the course of the river, and fill up the present course of the Thames, thus connecting south and north permanently, and allow of all streets south to north to be continuous. Such a course would involve an enormous expense, and hardly be favoured by the Londoner. It would also make all our valuable waterside warehouses useless.

"The authors believe that the scheme propounded by them will solve the whole difficulty at practically no cost to the taxpayer. We must bear in mind, that whereas road traffic will increase, river traffic is getting less and will in due course almost disappear. The authors propose to create an island in the river without, however, interfering with the free passage of the water, the deduction of waterway being made up by giving additional depth. The invention of reinforced concrete has made such a scheme possible, and to the modern engineer it is not a difficult problem to construct such an island, or rather, platform, carried on reinforced concrete piles. On either side of the river a free waterway of, say, 120ft. width, would be left of the requisite depth. The island platform would vary in width from between 300ft. to 500ft., and laid out with roads and blocks of buildings. The island would form a continuous building area, suitable for hotels, offices, flats, shops and any other class of property, and public gardens. The present banks of the river and the island would be linked up by a series of bridges, say, 40ft. wide, and occurring in the course of the roads leading north and south, generally providing two additional bridges of comparatively small spans in between either two of the existing bridges. By these means, the traffic would be spread over the whole area of the river, and any accumulation such as now exists would be impossible. Where public buildings, such as the Houses of Parliament, the County Hall, &c., occur, the island site would not be built on, but kept low and laid out as parks, so that the view of these buildings would not be interfered with.

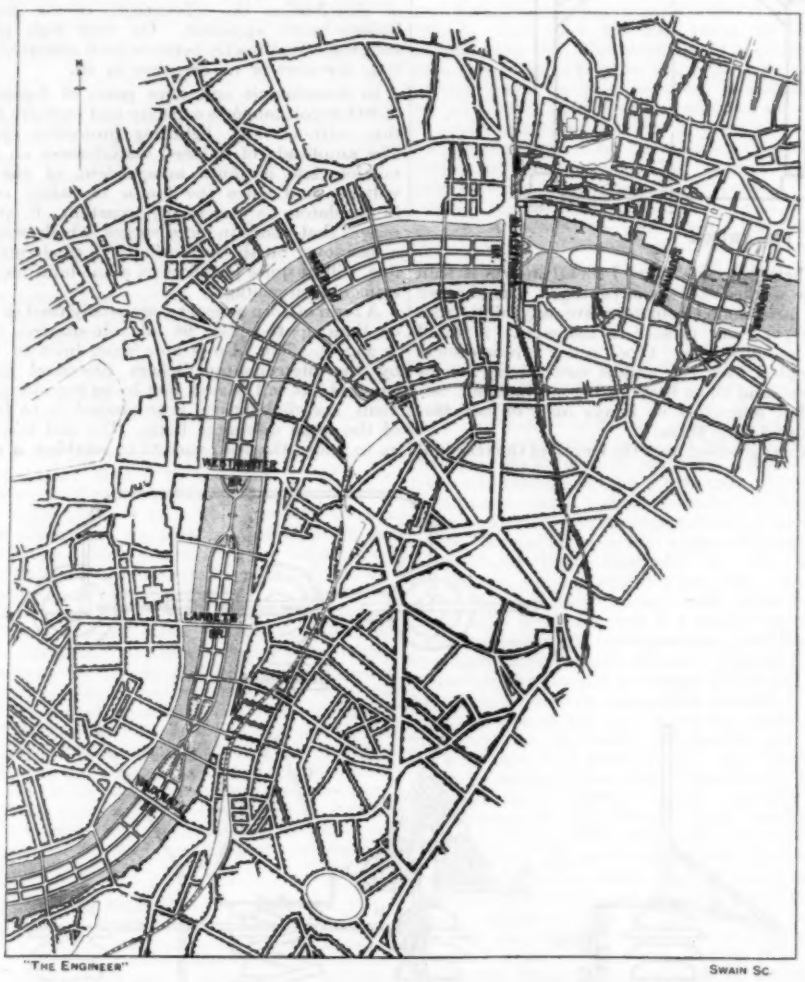
"Looking at the scheme from a financial point of view, it is astounding what a small amount of property would require to be purchased or reconstructed to form approaches, and, moreover, practically speaking, the building land thus erected would amply compensate for the expense thus incurred, and, indeed would more than cover the cost of the scheme, so that the remedy of the evil now existing would cost the taxpayer nothing at all. A large area of foreshore on the south side would be reclaimed at the same time, and work found for tens of thousands of unemployed in all trades.

"The authors claim that the beauty of the river would not be spoilt but improved. Who can possibly call the muddy south river front beautiful as it is now?

"The free waterways on either side would enable the river traffic to and from the wharves and warehouses to be kept up, and last, not least, the execution of the scheme could be dealt with in sections, thus causing no inconvenience to speak of to anyone, and spread over many years.

"It may be pointed out that a reinforced concrete structure is permanent, and does not require periodical painting and other maintenance charges. The erection of a large area of new building sites in the heart of London will enable the authorities to do away with slums and to replace congested areas. Generally speaking, the island would be built in terraces, and vary in level, in sympathy with the levels of embankments and existing bridges, but a road in the centre of the island would connect up the existing bridges. It is obvious that fast vehicles like taxis, motor cars, &c., would use the island roads, and the new bridges, thus leaving the existing bridges and roads for the almost exclusive use of heavy and slow vehicular traffic.

"The drawing attached hereto does not show the roads on the island in detail nor the setting out of the building area, but is simply to give a general idea of the scheme."



PLAN ILLUSTRATING PROPOSED SOLUTION OF THE LONDON TRAFFIC PROBLEM

Indian Engineering Notes.

(*From our own Correspondent.*)

The Sukkur Barrage.

Of the many engineering projects at present under consideration in Western India, interest centres around the Sukkur Barrage scheme in Sind. Engineers and laymen in that portion of the Bombay Presidency have decided that unless the scheme is put through Sind will be ruined, and the movement has been taken up by some of the newspapers. Letters and articles dealing with it from all points of view appear each day on the subject, but so far the Government has not been sufficiently aroused to make a statement. The article on the Sukkur Barrage—see page 190—illustrates the extent of the improvement that will be effected; but the main stumbling block is the large amount of expenditure involved and the time that must elapse before any return is obtained on the investment, either by the Government or the private capitalist. In the course of a statement to the Press, Sir Montagu Webb says:—"Expert opinion confirms the fears of the Sind public that if the Sutlej Valley Irrigation project be allowed to draw off twenty to thirty thousand cubic feet of water per second from the Sutlej and Chenab rivers, the level of the river Indus at Sukkur must be seriously affected at the seasons of the year critical for the Sind cultivators. Without the Sukkur Barrage, therefore, Sir John Benton's warning as to the possibility of a ruined Sind is likely to find confirmation in the not remote future." The Sutlej Valley irrigation project was referred to in my last letter.

Industrial Activities.

Several industrial undertakings are springing up all over India, one of the most interesting recently registered being the Shri Mahaluxmi Sugar Corporation. This company, which is supported by several influential zemindars of the United Provinces, proposes to erect a crushing plant of the capacity of 500 tons of cane a day, and also to carry on intensive cultivation of the cane on modern scientific lines. Another interesting enterprise is that of the Bengal Accumulator Company, which is to manufacture electric storage batteries for all purposes. Other smaller undertakings include cotton spinning and ginning mills, factories for the manufacture of oils and paints, &c.

Humidification in Cotton Mills.

The humidification expert to the Government of India has recently been conducting a number of experiments in this connection in the Bombay and Ahmedabad mills. In the course of a paper presented before the Bombay European Textile Association recently, he outlined these experiments and some of the results he obtained. A portion of the paper was devoted to the principles of humidification and some hints as to how to obtain the best results in experimental work in that connection, but he later dealt with his experiments and gave some interesting figures to show the advantages that might be gained by the use of humidification in the Indian mills.

The Sri Krishnarajendra Mills.

Considerable progress has been made recently in the establishment of the Sri Krishnarajendra mills in Mysore. The buildings have all been erected, and the machinery, of which two-thirds has already arrived in India, is being installed. The main block, which occupies an area of 4 acres, accommodates the carding, spinning, baling and bundling impedimenta, the blow room and mixing room. The power here will be supplied by four electric motors with a total horse-power of 850. The reeling section is practically complete and contains eighty-four forty-double hack reeling frames. A battery of bundling presses, together with a 25-ton electric baling press, have also been installed. The latter appliance, which differs from the orthodox type of hydraulic press, is driven by a 3½ horse-power engine. The main section necessitated the use of 300 tons of steel in its construction, and it is interesting to note that all the steel trusses and stanchions were built on the spot in a workshop specially erected for the purpose. The dyeing and bleaching section is equipped with two Hursong patented dyeing and bleaching machines, and a hydro-extractor by Thos. Broadbent and Sons. Electrical energy is employed throughout.

Discussions are proceeding between representatives of the railway companies and of the men's unions as to the application of the recent award of the Industrial Court that the wages of craftsmen employed in railway workshops shall be reduced by 16s. 6d. per week in three instalments. Apparently the unions have accepted the position, and the point under discussion is as to what date the change shall operate from.

A Dynamic Balancing Machine.

THE problem of balancing high-speed machinery has, of course, been attacked from a variety of points of view and in some cases subterfuges, such as the flexible shaft of the De Laval turbine and the floating bearings of the early Parsons machines, have been adopted on account of the difficulty of balancing dynamically a body rotating at a high speed. Turbine manufacturers, specially, have been troubled with this difficulty, and only a few years ago, men who had the knack of balancing were at a premium, while large numbers of machines of other classes have been put in service in an unsatisfactory condition on account of the expense involved in balancing their rotating parts. Within recent times, however, many efforts have been made to put the subject of balancing on a more scientific basis, with the idea of evolving a process which would be both expeditious and economical, and several systems have been developed.

One of the most promising solutions of the problem with which we have become acquainted is that represented in the Lawaczeo-Heymann machine, made by Carl Schenk, who is represented in this country by Mr. C. F. R. Giesler, of 58c, Gray's Inn-road, London, W.C. 1. It is claimed that with the aid of this machine it is possible to get a rotor into exact dynamic balance without the exercise of any technical knowledge on the part of the operator, and generally, it only requires two or three trials to get this result. The machine, as it is at present developed, is only applicable to symmetrical bodies having a simple rotary motion and a comparatively stiff shaft, but it is hoped before long to produce apparatus with which pieces of more complicated shape, such as crank shafts, or others with flexible spindles, may be balanced.

The difference between the static and the dynamic balance of a rotating body, that is to say, the mere balancing of the gravitational forces of its component parts when at rest, or, on the other hand, of the centrifugal forces produced by those parts when rotating, is too well known for it to be necessary for us to go into the subject here; but it may be as well to point out that when using the machine under review no consideration need be given to static balance. It is the practice in some shops to balance rotors statically on knife-edges as a preliminary step, but this process has the disadvantage that balance weights may then be put on in such positions as to aggravate the lack of balance when rotating. Unless a rotor is so badly out of balance as to be palpably liable to damage the bearings when run up to speed, it is put directly into the Heymann machine and the dynamic balancing proceeded with.

The essential parts of the machine are a pair of ball bearings, so mounted and equipped that they can accommodate any rotor within the intended capacity, a driving gear, and a set of recording instruments with which graphs of the vibrations of the rotor can be made. The bearings have spherical seats and are mounted on the upper ends of springy pillars fixed to the base plate. These pillars are stiff axially to the rotor, but can flex sideways and have a flexibility in that direction which is chosen in accordance with the probable lack of balance to be contended with. Arrangements are made for clamping the bearings rigidly to prevent their vibration, and they are equipped with sets of bushes so that they may accommodate various shafts. The driving gear comprises an accurately balanced gear wheel, which is fixed on one end of the rotor and meshes with another wheel driven in any convenient manner. The latter gear wheel is mounted on a splined shaft, so that it may be drawn out of gear with that on the rotor. The drive must be capable of reversal.

The first operation in the process of balancing is to determine in which directions the shaft is liable to deflection by the unbalanced centrifugal forces. This operation is carried out individually for the two ends of the rotor and is effected by clamping on to the end of the shaft a little frame containing a disc of paper. Over the paper there is a sheet of copying paper and then a protecting sheet. A stylus pressing on the protecting sheet is used to make the diagram. This stylus is connected with a system of levers, pivoted on a fixed part of the machine and so arranged that if the rotor, and its bearing, move to the right the stylus moves to the left on a magnified scale.

When the paper frame has been prepared the driving gear is put into operation and the rotor run up to speed. The toothed gearing is then disengaged, so that the rotor is quite free from outside influence and goes on running on account of its inertia. The fastenings of the bearing at the end which is being dealt with are then cast off. At some speed or other of the rotor the period of the vibrations caused by its lack of balance will synchronise with the natural period of vibration of the spring supporting the bearing, which will then wobble violently. At this moment the stylus will have a considerable range of movement across the end of the shaft and will make a lobe-shaped diagram that may be as much as two inches across. The excentricity of this diagram does not, however, correspond with the direction of the unbalanced weight, which is always in advance of the excentricity to some unknown extent. The carbon paper is then taken out of the frame, another piece of a different colour put in its place and the process repeated, but with machine running in the reverse direction. The result will be two diagrams which intersect one another in a clearly defined plane. This plane is the one in which the balance weights must be put, and it is a simple matter to transfer the mark, by means of a scribing block, to the periphery of the rotor. A trial balance weight is then temporarily fixed in place and the rotor run up to speed again. A pointer attached to the bearing shows if the vibrations have been reduced or, possibly, eliminated. In any case, the mass of the balance weight is adjusted—its position need not be altered—until the bearing entirely ceases to wobble. It may then be said that that end of the rotor is truly balanced. During this process the opposite end of the rotor has been prevented from vibrating, although the bearing has been free in its spherical seating to accommodate the vibrations of the end operated on. A second operation is thus necessary to get this end into balance, and is carried out in precisely the same way as that just described, with the natural difference that the bearing first left free is now clamped while the other is free to wobble. When the second end has been satisfactorily balanced, a final confirmatory run is made, with both bearings free, to test the balance of the rotor as a whole.

The machine which we inspected in London was capable of accommodating rotors of comparatively small dimensions, but we understand that some have been ordered for this country capable of taking the rotating parts of the largest steam turbines at present contemplated.

Visit of Young Engineers to South Wales.

THE Graduates' Association of the Institution of Mechanical Engineers joined forces with the London Students' Section of the Institution of Electrical Engineers for the purpose of a joint visit to South Wales. The party arrived at Cardiff on Monday, July 24th, and was received by Mr. David E. Roberts, Professor F. Bacon and Engineer-Commander W. H. Reynolds, vice-president and joint honorary secretaries of the South Wales Branch of the Institution of Mechanical Engineers. At an informal dinner, held at Barry's Hotel, Mr. Roberts welcomed the visitors, and announced that the Council of the South Wales Institute of Engineers had been pleased to place their headquarters in Park-place at the disposal of the party during its stay.

On Tuesday, the 25th, the party proceeded to the Melingriffith tin-plate works, where it was received by Mr. W. R. Davies, works manager, who personally conducted the visitors in an exhaustive tour of the works. Luncheon was taken at the works, and a vote of thanks to Mr. Davies and his assistants was proposed and carried unanimously. At two o'clock the party proceeded by the firm's private railway to the base of the Garth Mountain. A ramble over the mountain and the adjacent country then followed. Tea, brought out by Commander Reynolds, was taken on the return walk to St. Fagan's, where the party entrained for Cardiff.

On Wednesday, July 26th, the party caught an early train to Swansea, where it was met by members of the Association of the engineering students of the University College of Swansea. The morning was devoted to visiting the Hafod copper works and Messrs. Baldwins works at Landore. The party lunched at the Exchange Restaurant, where it was joined by Mr. J. W. Burr, borough electrical engineer. After an enjoyable afternoon spent at Langland Bay, the return was made by a late train.

On Thursday morning the party was afforded a novel experience, being conducted over the underground workings of the Britannia Pit, belonging to the Powell Duffryn Steam Power Company. The evening was occupied by a pleasure trip to Weston, which, thanks to the clemency of the weather, was most enjoyable.

On Friday, July 28th, a visit was made to the Barry Docks and Railway Works, Mr. Pennington, the Docks Superintendent, personally conducting the party; proceeding by char-à-banc, a picnic lunch was made at the Leys. In the afternoon the Aberthaw and Bristol Channel cement works were visited.

In the evening the party was entertained at dinner by the local branches of the Institutions of Mechanical and Electrical Engineers. The President of the South Wales Institute of Engineers proposed the toast of the "Guests," who had so kindly allowed their works to be inspected, to which Mr. W. R. Davies, works manager of the Melingriffith tin-plate works, replied. Mr. McWhirter, President of the local branch of the Institution of Electrical Engineers, then proposed the toast of the graduates and students; the chairman of the Graduates' Association, replying for the party, thanked the President and his colleagues for their kindness and help, to which, he said, the success of the visit was so largely due, and the Council of the South Wales Institute of Engineers for its generosity in placing its headquarters at their disposal.

On Saturday the tour was brought to a close by a visit arranged and led by Mr. Allen, the honorary secretary of the local branch of the Institution of Electrical Engineers, to the Municipal Buildings, Law Courts, and Fire Station.

PERUVIAN RAILWAY CONTRACT.

THE following particulars concerning the railway and land concession recently granted to Mr. R. W. Dunsmuir, of Vancouver, British Columbia, by the Aministration of Peru have just been made public. The railway concession, which covers a period of forty-five years, was not lightly obtained. Several rival claimants, including British, American and German representatives, were in the field, and the Government took eighteen months to arrive at a decision.

The projected railways comprise:—(1) Huancayo-Ayacucho; (2) Chimbote to some point on the Cerro de Pasco Railway, owned by a United States mining company; (3) from the Cerro de Pasco Railway to a point on either the Pachitea, the Ucayali or the Huallaga rivers; (4) from Ayacucho to Cuzco; (5) from Pisco to Huancavelica; (6) from the capital (Lima) to Pisco; (7) from Huacho to Lambayeque; and (8) from Chuquicara, a station on the Chimbote Railway, to Jaen, situated at the headquarters of the river Marañon.

The existing systems of railways of the Republic have long proved inadequate to meet the industrial and agricultural demands, but the new construction, when carried into effect, will double the existing mileage, and, by passing through rich, but undeveloped, agricultural and mineral territory, should add greatly to the economic potentialities of the State. In fact, strategically as well as industrially, the new construction should prove of considerable value to Peru. The western provinces, for the first time, will be brought into direct communication with others situated in the east, while the proposed lateral systems of railways, will open up mineral and agricultural districts in the Andean valleys hitherto deprived of means of transport other than those provided by the slow pack animals such as llamas and asses. From the sea-level to the heights of the Andes, and thence to the Amazon basin, the new railways are designed to deal with the transportation of innumerable natural products, most of which are expected to find a ready market in the principal towns and cities within the State. At the end of the period of fory-five years the whole of the railways will revert to the Peruvian Government, but the concessionnaire will be entitled to purchase them outright by paying to the State the original cost of construction.

The Dunsmuir concession covers a valuable monopoly in connection with tobacco cultivation, extending over a period of thirty-three years. To provide for the exploitation of this industry, a separate company is to be formed. Similar measures will be followed with regard to the petroliferous deposits, which have, it is said, been proved to exist upon the lands conceded, and which lie mainly in the eastern portion of Peru. The mineral and petroleum deposits will have to be developed within the period of thirty-three years. For the output, favourable shipping facilities will not be lacking; the sea distance between the oilfields to be exploited and London is actually further than that of the Mexican oilfields at Tampico, but the cost of transportation down the Amazon River—a length of 2600 miles—is expected to work out considerably cheaper.

COTTON CULTURE IN AUSTRALIA.

THE campaign in the Commonwealth to secure more extensive cultivation of cotton is proceeding without remission in the three Eastern States. The Governor-General is sparing no opportunity to give an impetus to the movement. He has urged that all interested should do their best to ensure that the enterprise shall be brought to success, especially as there are enormous areas in the Commonwealth suitable for the cultivation of cotton.

The managing director of the Australian Cotton-growing Association states that the association had by the middle of July paid £50,000 for cotton received at its ginneries at Rockhampton and Brisbane. According to a member of the Queensland House of Assembly, the cotton crop in Central Queensland next year will be worth in the region of £1,000,000. In the Northern Rivers district of New South Wales considerable interest is being displayed in the industry, the prospects for developing which are considered to be bright. The Department of Agriculture is securing seed, which will be distributed in those areas in which it is considered that the cotton plants will best thrive. The Queensland Government guarantees 5½d. per pound to growers for all cotton delivered to the ginneries, and the New South Wales authorities have intimated to farmers that the question of guaranteeing a price in that State is under consideration. In the Northern territory two considerable areas have been taken up under lease, and are being sown with cotton. One company has a tract of 120 square miles, and another an area of 77 square miles. The Federal Government has notified its willingness to guarantee individual growers a return of 5½d. per pound for cotton delivered at the ginneries, up to a maximum of £100, including cost of transport. Any further general guarantee, states the Minister for Home and Territories, would involve a matter of policy. Experiments carried out in the north and north-western parts of Victoria in the matter of cotton culture are officially regarded as satisfactory. The cotton is declared to compare favourably with the Queensland product. Further experiments will be conducted next season; meanwhile the Agricultural Department has attested its readiness to supply free samples of seed to any landholders willing to sow an experimental plot.

Strict precautions are being taken against the introduction into Australia of any of the diseases associated with cotton cultivation in other countries. The direct importation of seed is not allowed. All seed arriving is quarantined, and a sample planted by the State authorities. The cotton produced is then carefully inspected before the seeds are made available for general use.

FOREST CONCESSIONS IN BULGARIA.

THE Sobranyé, before the end of the session, passed a Bill authorising the Minister of Agriculture and Domains to grant by means of a public adjudication a concession for the exploitation of the forests belonging to the State situated (1) in the central Rhodopes, with an area of about 60,000 hectares of pines, and (2) in the districts of Vassilico and Malko-Tirnovo, on the Black Sea, consisting of about 100,000 hectares of oak and beech. The concession period for the Rhodope forests is sixty years, and for the Vassilico and Malko-Tirnovo forests fifty years.

The object of the concession is not only the cutting of wood in the forests, but also the transformation by mechanical or chemical means of the rough wood into objects or products for consumption, as well as the construction of a narrow-gauge line—76 cm.—from Kritchim to Diovlen, with the necessary branches, for the transport of material cut in the central Rhodopes, and of another line from Vassilico to a point north of Malko-Tirnovo, on the Black Sea, with the necessary branches. These lines will have to be constructed within five years from the signing of the contract.

The Bulgarian State will receive a percentage—to be proposed by the tenderers—on the net profits realised by the sale of the products of all kinds obtained from these concessions. The capital invested in the undertakings will be free from all taxes during the period for which the concession is granted. At the expiration of the period all the constructions, installations, railway lines with rolling stock, machinery, &c., will fall into the hands of the State without any indemnification to the concessionnaires.

The Minister of Agriculture and Domains will shortly announce the date of the public adjudication of the two concessions. Persons desiring to take part must deposit a guarantee of 300,000f. gold for each concession, either in cash or in securities issued or guaranteed by the State.

Gas Driven Power Plant Using Wood Fuel.

A LARGE gas-driven electric power plant at the Lonely Mine, Southern Rhodesia, is the largest wood refuse gas plant in South Africa. It was installed recently to replace existing steam plant, the boilers for which used at the rate of some 3000 cords of wood as fuel per month for steam raising purposes. Owing to the isolated position of Lonely (43 miles from Bulawayo the nearest railway connection) the use of coal was out of the question on account of the heavy cost of haulage. Wood from the local bush therefore had to be used, but the enormous consumption of it during the past 11 years of life of the steam plant had caused the clearing of the bush to a radius of 11 miles, and had the consumption continued at that rate for three years more the economic limit would have been reached. The cost of wood fuel had indeed become one of the most serious factors of the mining costs, so that some radical change became absolutely necessary.

The question consequently received very close and careful attention by Mr. C. B. Kingston, general manager and consulting engineer, and Mr. J. N. Bulkley, consulting mechanical engineer to the Lonely Reef Gold Mining Company, Limited, by whose courtesy we are enabled to give particulars, together with details of tests, and to reproduce some photographs of the new installation.

The decision was taken to adopt electrical driving wherever possible, using individual motors and alternating current supplied from gas-driven alternator sets working in parallel and operated by producer gas generated from wood fuel.

The gas producing plant is of special design, comprising the gas generators, from which the wood fuel is fed into the hoppers. The wood used is about 10in. in diameter and is cut into pieces about 2ft. in length. The feeding-hopper mounted at the top of each gas generator is of the air-lock type. The hot gases as they leave the generator first pass into a wet scrubber where they are washed and cooled. Within this wet scrubber much of the tar coming over with the gas is condensed and carried away by the cooling water into settling tanks, where it collects and is afterwards removed. The effluent water ultimately flows away in a comparatively clean state.

Fig. 2, page 194, from another photograph of the gas plant shows an end view. Here in the foreground can be noted the arrangement of the various vessels comprising one complete gas plant unit. The wet scrubber referred to is the tallest vessel in the centre. The gas enters it at the base and passes upwards, meeting in its course a cascade of cooling water which falls from the top. The cooled gas leaves the scrubber at the top and descends through the vertical piping into a centrifugal tar extractor situated on the floor level. This extractor runs in ball bearings and is direct driven by an electric motor. Here further traces of tar and tarry deposits are effectively removed from the gas, which then enters the dry scrubber where any particles of moisture are got rid of. This scrubber is shown to the left-hand side of Fig. 2. All of the four dry scrubbers—one to each gas plant unit—are coupled together in a manner that will be referred to later.

Gas Engine Sets.

The four gas engine sets supplied by the Premier Gas Engine Company, Limited, Sandiacre, near Nottingham (associated with Crossley Brothers, Limited), are all of the firm's horizontal multi-cylinder type, all with cylinders of 17¼in. bore with a stroke of 26in. As already mentioned mixing of the gases together after they leave the dry scrubber. A further point is that the suction from each of the gas engines when in operation is more evenly distributed, with the result that each gas generator responds to its fair share of the load and generates gas in proportion.

Tests.

Tests were carried out upon the installation by Prof. Buchanan, B.Sc., of Johannesburg, and the following particulars are extracted from his report dated February 21st, 1922:—

The main object of the tests was to determine the quantity of dry wood fuel consumed within the gas plants in generating 1 Board of Trade unit of electricity. A twenty-four hours' continuous test was made first, working under normal conditions, but using only two producers, those being sufficient to serve the three 200-kilowatt gas engine alternator sets. The fourth engine, which is used for driving the air compressor, was not tested, one of the gas producers being coupled up to serve this engine exclusively during the test. The fourth producer was shut down entirely throughout the tests.

Care was taken to note that the amount of fuel within the producers was the same at the beginning and finish of the test. The wood fuel used was of a normal mixture of Mapani, Knobby-Thorn, Marula, and other soft woods.

Details of Tests.

Date of test	February 2nd and 3rd, 1922
Duration of test	24 hours 13 min.
Total units generated measuren at the switchboard	11,530 units
Average load from three sets	477 kilowatts
Load factor (say, 160 kilowatts per set)	80 per cent.

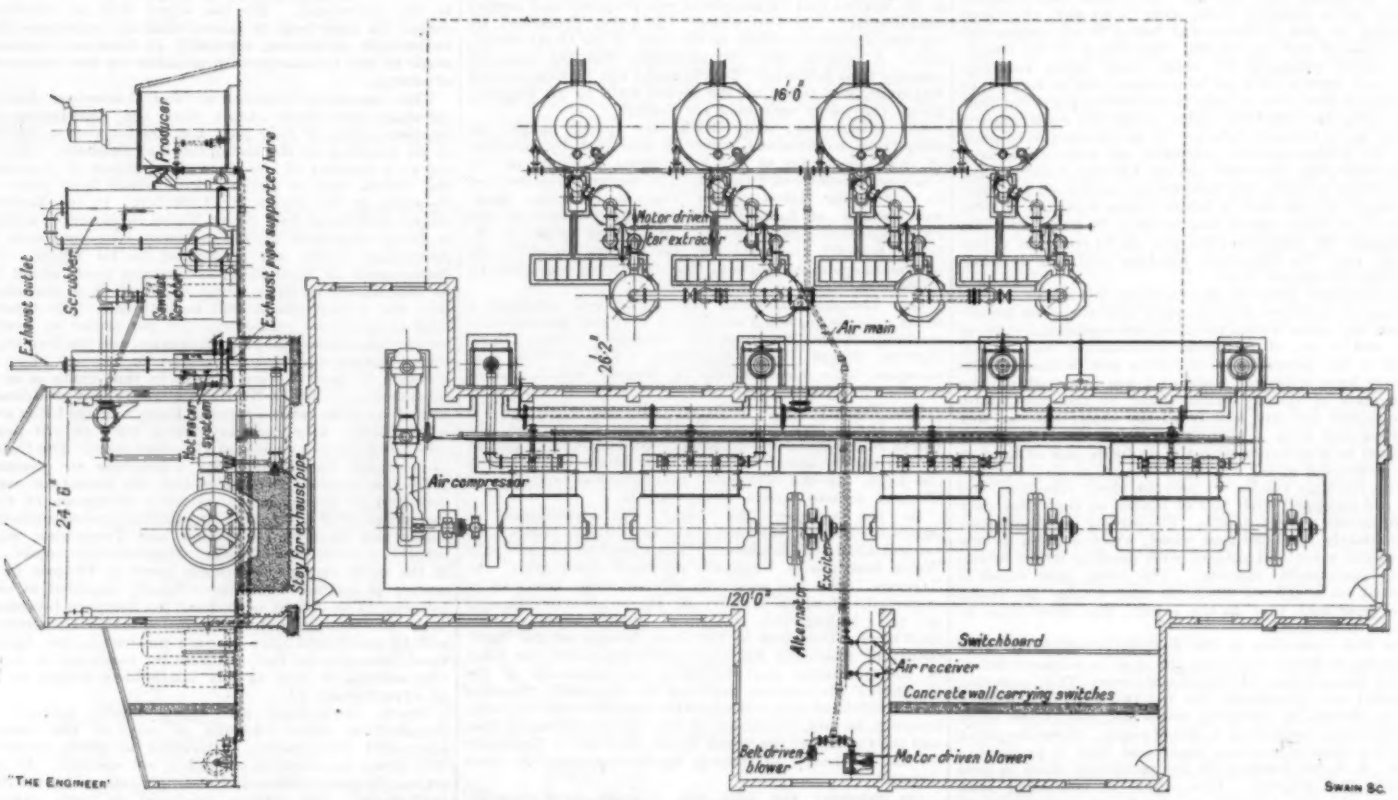


FIG. 5—PLAN AND CROSS SECTION OF THE POWER HOUSE AT LONELY MINE

Crossley wood fuel suction gas plants in four units each at 350 horse-power, giving a total capacity of 1400 horse-power. But as each gas plant unit is able to take overload up to 450 horse-power, any three units can meet the total power requirements, leaving one unit as standby. These gas plants serve four Premier multi-cylinder horizontal gas engines. Three of these engines are of the four-cylinder type, direct coupled to alternating current generators, whilst the fourth, which has three cylinders, drives a large air compressor direct through a flexible coupling.

As the result of installing this gas power plant the fuel consumption has been reduced to some 600 cords per month, or one-fifth of the previous fuel consumption upon the steam plant. What this means in actual effect upon the mining costs is shown from the consulting engineer's quarterly report, which states:—"The total cost of power in December was £1645, as compared with the average cost of £4557 when the steam plant was in use.* The saving effected by the gas plant is considerably in excess of the estimated saving, and is equivalent to a reduction in the working costs of over 10s. per ton milled." A further point of very considerable importance is the fact that, when using wood fuel in the steam boilers, the soft green Marula trees could not be burned, and were therefore left standing in the area already cleared of all other wood. It is now found that these trees can be satisfactorily used as fuel in the Crossley gas plant, and, in fact, give excellent results.

Gas Plant.

Before dealing with the tests it may be well to give the following additional details:—The complete gas producing plant was supplied by Crossley Brothers, Limited, of Openshaw, Manchester. It is illustrated in Fig. 1, page 194, which is reproduced from a photograph taken on the site, and shows the large overhead platform built around three of the engines drive three-phase alternators, each of 250 k.V.A. capacity at .8 p.f. with 525 volts at 187.5 revolutions per minute. These alternators were supplied by the S. A. General Electric Company, Limited. The gas engines are designed for 300 brake horse-power normal working load and will carry a 25 per cent. overload. The fourth engine develops 225 brake horse-power at 190 revolutions per minute and is connected through a flexible coupling with an Ingersoll-Rand air compressor having a capacity of 1500 cubic feet per minute. Fig. 3 is reproduced from a photograph of the power station and shows the arrangements of engines viewed at the crank shaft end. Fig. 4 is another view of the power station, and shows how one of the alternators is mounted on the crank shaft alongside the engine fly-wheel.

Fig. 5 shows a general arrangement plan and elevation of the complete equipment within the gas plant and engine houses. The gas piping arrangement already referred to is clearly shown, as is also the exhaust piping, a part of which is water jacketed to supply a service of hot water for baths and washing purposes. Air storage receivers are provided for starting up the gas engines. They are charged up from motor driven compressors.

The question of operating the alternator sets in parallel with each other was given very special consideration by the manufacturers. So far as the gas engines are concerned they are easily capable of fulfilling the required conditions, being of the four-crank type and designed to give a degree of cyclic irregularity not exceeding 1/500. To ensure this degree of steadiness under all conditions of working a uniform quality of gas must be supplied to the engines. For this reason a special arrangement of equaliser pipes was introduced between the dry scrubbers of the gas-producing plant, and arranged in the following manner: The scrubbers are first coupled together in pairs by means of overhead pipes and these pipes in turn are coupled together and lead into one common main delivery pipe. The arrangement can be noted in Fig. 2 and is interesting as showing the means adopted for ensuring thorough

Corresponding power developed by each engine (89.5 per cent. alternator efficiency)	239 brake horse-power	
Total wood fuel used during test	41,208 lb.	
Fuel used per hour	1703 lb.	
Fuel consumption rate at 80 per cent. load	Per B.H.P. 2.39 lb.	Per K.W. 3.575 lb.
Average moisture content in fuel	13.5 per cent.	
Equivalent dry fuel consumption rate at 80 per cent. load	Per B.H.P. 2.07 lb.	Per K.W. 3.09 lb.

The makers' guarantees given with dry wood fuel were as follows:—

	Lb. per B.H.P. hour.
At full load	2.0
At three-quarter load	2.23
At half load	2.76
At quarter load	3.9

A curve made from the makers' guarantees shows that at 80 per cent. load the corresponding fuel consumption would be 2.15 lb. of dry fuel—see Fig. 6. As may be seen, therefore, the actual test result is 4 per cent. below the guarantee.

The watt-hour meter was calibrated before leaving Johannesburg and the station instrument and feeder watt-meters checked against it. The net difference in the readings was within 2 per cent.

After the main test and whilst the three sets were operating in parallel with a load of about 500 kilowatts, first one, then a second sparking plug was disconnected from one engine (thus cutting out two cylinders) without causing any appreciable effect in the parallel operation of the machine. No doubt the synchronising current was increased, but owing to the load fluctuations the difference could not be observed.

After continuous running on ordinary load, one of the alternators was taken off load, leaving two machines operating at 400 to 460 kilowatts for over two hours. This represents more than 10 per cent. overload. Temperature readings taken at the field and stator windings immediately the machine was shut down showed that the temperature

* Later information from the consulting engineer at the mine for six months' working now shows the average monthly saving to be £3015—due to the new gas power plant.

increase was within the usual guarantee of 50 deg. Cent.

The power factor indicator was provided with resistance coils for 110 volts, which were unsuitable for the voltage of 280 to neutral, so three transformers belonging to the mine were used to reduce this pressure; the readings, however, seemed not quite consistent and were not noted during the test. Instantaneous reading of volts, ampères and kilowatts, were, however, taken every half hour, and although it was difficult to get a steady value, owing mainly to the varying synchronising current, the average over any particular period must be fairly correct.

From 11.30 to 2 p.m. the average total load was 580 kilowatts, average ampères, per machine, 296 per phase, and volts 524, which gives a power factor of 0.72.

From 3 p.m. to 5.30 the average total load was only 440 kilowatts, 246 ampères, per machine, volts 530, giving only 0.65 power factor.

In both cases the value is for the generators themselves, including the synchronising current.

A test made during the afternoon with an ammeter measuring the whole current from the three machines, usually read about 5 per cent. lower than the sum of the three ammeters. The load values for the power factor

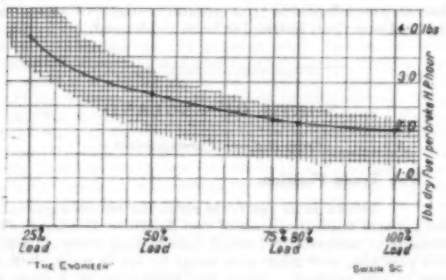


FIG. 6—FUEL CONSUMPTION AT VARYING LOADS

would thus actually be about 5 per cent. higher than those given above, or, say, 0.77 at 580 kilowatts and 0.70 at 440 kilowatts.

Cost of Wood Fuel.

The average weight of a "cord of wood" was carefully checked from samples made up by boys and afterwards weighed. Marula wood gave 3000 lb. and Mapani 3600. The average therefore would be fairly represented by 3300 lb. to the cord, at an average price of 15s. per cord. Taking the fuel consumption to be, say, 3.6 lb. per unit (kilowatt) generated, the cost works out at less than 0.20d. per unit for fuel.

Water Consumption for Gas Plant.

The quantity of water used for the gas plant scrubbers, &c., was carefully ascertained from measured tanks and was found to amount to 2850 gallons per hour, equivalent to a rate of approximately 4 gallons per brake horse-power. The temperature of water inlet was 84 deg. Fah.

Gas Analysis and Calorific Value.

The official analysis of the constituent gases from the gas plants and their calorific value is given below. The variation in the samples is due mainly to the condition of producers as regards stoking and charging, and illustrates the importance of mixing the gases from the different producers before use at the engines.

Copy of Gas Analysis, &c., from Department of Analytical and Research Chemistry.

University College, Johannesburg,
February 17th, 1922.

To Professor Buchanan, Johannesburg.

Dear Sir,—The following is my report on four samples of producer gas from Lonely Mine, submitted by you. The bottles were not numbered, so, for convenience, they were given the numbers 1 to 4, according to their position in the basket.

Calorific Values (gross).

These were determined by direct combustion of a known volume of the gas in presence of oxygen. The figures given represent B.Th.U. per cubic foot, at 760 millimetres pressure at 0 deg. Cent.

No. 1	148
No. 2	172
No. 3	160
No. 4	166
Average	161.5

A composite sample consisting of approximately equal proportions from each bottle was analysed by means of a Hompels apparatus, with the following results:—

	Per cent. by volume.
Carbon dioxide	1.8
Oxygen	2.5
Carbon monoxide	22.9
Hydrogen	15.4
Methane	1.0
Olefines (ethylene, acetylene, &c.)	Traces
Nitrogen (by diff.)	56.4

By calculation this gives a gross calorific value of 142 B.Th.U. per cubic foot. This figure cannot, however, be regarded as being so accurate as those obtained by direct combustion, in the Mahler calorimeter, owing to the limitation of technical methods of gas analysis in determining and differentiating small proportions of hydrocarbon gases.

These results show that the gas is of high standard somewhat above the average for producer gas.—Yours faithfully,

(Signed) N. B. Adam.

Concluding, Prof. Buchanan states:—"The whole plant seems well able to give its guaranteed output. The engines run remarkably smoothly with absence of noise and are of ample capacity for their duty. The producers also appear to have sufficient capacity to enable the normal load to be obtained with one in reserve. Some 200 gallons of tar were produced from the whole plant during the twenty-four hours' test."

Provincial Letters.

THE MIDLANDS AND STAFFORDSHIRE.

(*From our own Correspondent.*)

The New Steel Situation.

The interests of steel continue to obsess the Birmingham market above all other material. "What's your price?" addressed by steel buyers to sellers, never brought such a variety of replies as to-day, and buyers were never more insistent upon putting this cardinal question before placing any order whether large or small. My remarks have reference mainly to rolled steel, and consumers' curiosity is dictated chiefly by the reductions which have recently originated on the Scotch and North-East markets, but semi-manufactured material is this week also once more a matter of considerable price fluctuation on Birmingham Exchange. Respecting the former, and particularly with regard to sections, the freeing of the market from price restrictions has produced a state of things which places current quotations almost topsy-turvy. Everyone is now keenly after orders, and the lowest district and the lowest seller invariably takes the business. This, at any rate, was the experience on the open market to-day—Thursday—and the condition was only a reflex of what I am told has now become the daily situation at the works. No one will buy except at the absolute bottom. Even then orders are not given out at all freely. Consumers are looking for a further fall in prices later on. Steel makers in all parts of the kingdom now having a free hand, it cannot but be that buyers' anticipations will sooner or later be realised. Unrestricted competition must perforce bring down values. About £9 seems to be the most general quotation for angles and sections, and ordinary plates are also £9, but, as last week, there are works who continue to make £9 10s. their minimum. Some makers selling in the North-West Midlands demur to either figure as being too low, while others are reported to be ready to close at even less than £9 to secure the business which they so urgently require. It will take a little while for the new position to define itself. Prospective buyers are moving cautiously. Happily, the engineering industry has fairly put itself in readiness for retrieving the trade situation if at all possible in the coming autumn. Certain big consumers in this direction were this week reported to be sounding the market with regard to supplies, and there is believed to be some promise of construction projects which have been long in suspense being put in hand. A better undertone, therefore, attaches to the demand for rolled steel, and the market is somewhat more optimistic than of late. When consumers are satisfied that the bottom has been reached, the Birmingham market will undoubtedly take a big bound forward. The problem as to whether this level has been reached is, however, too indefinite at the moment to compel or to permit of any large amount of buying. The recent rolled steel reductions have brought out a number of orders which had been held in abeyance, but many of them are for small lots. It is a proof of undoubted trade revival that the output of steel ingots and castings the country over the last month is returned as the best tonnage for twelve months past, and the tell-tale line of the barometer in this connection is, fortunately, pretty certain to continue to ascend. Respecting raw steel, another headlong raid for orders for steel semis this week is reported upon this market. Certain sheet manufacturers profess to be able to buy bars at £7, and billets are said to be obtainable at £7 2s. 6d. Whatever significance this development may have, the market level remains well above the prices mentioned, and some local firms would even profess that billets have settled down to a general basis of about £7 10s.

Staffordshire as a Raw Iron Producer.

Last week I reported that only four blast-furnaces were alight in the whole of South Staffordshire. It is a matter of considerable comment that the proportion of blast-furnaces in operation in this area compares very unfavourably with districts such as Northampton, South Wales, and the North of England. This district lags behind in the relighting of furnaces, chiefly because of the unfortunate position arising from excessive railway rates, and the fact that, with the exception of coal, the raw materials used in the furnace have to be transported over considerable distances. Complaints are rife of the transport charges for furnace material, and there is a feeling in iron and steel circles in this district that something should be done to re-establish the blast-furnace industry upon a remunerative basis, and that some further railway freight reductions should be made in regard to the carriage of coal and coke and raw materials. A suggestion was recently made by the Birmingham Chamber of Commerce that it would be in the interests of the railway companies to call a local conference of persons concerned with the blast-furnace industry in order to ascertain what can be done. The interests of the traders and the companies in this direction are regarded as being closely bound together. The recent advance in coke prices also adds materially to the cost of production and to the difficulty of competition. Makers of Northamptonshire pig iron, nevertheless, are, it is reported on Birmingham exchange, still competing successfully with Cleveland in the Northern and Scotch markets, underselling the North-East Coast by several shillings per ton. Endeavours to stiffen pig-iron quotations on the plea that coke is going up meet with very little encouragement this week. Current quotations are:—Northamptonshire forge, 70s.; foundry, 80s.; Derbyshire forge, 72s. 6d.; No. 3 foundry, 82s. 6d. at furnaces. A Northamptonshire blast-furnace concern is reported this week to have made sales engagements, which not only cover present stocks of iron, but will absorb future output at the furnaces for a short time ahead. Forward buying is exceptional however. It is difficult to trace any effects on the Birmingham iron market of the export demand for pig iron. The news of the partial settlement of the American coal strike, with the prospect of an early general resumption of work there, has rather checked buying. Consumers of pig iron, taking the kingdom as a whole, are not improbably looking for somewhat weaker pig iron prices when the American demand disappears, especially in view of the record large output from English collieries.

New Sheet Iron Prices.

New sheet iron prices are spoken of this week, following upon the drop of 10s. to 15s. per ton which has occurred in this commodity in Scotland. Prior to the Scotch fall, Midland quotations for sheets of 12 to 20 w.g. were generally regarded as about £11 15s. to £12 per ton. Now the price for the foregoing is more like £11 5s. to £11 10s. per ton, sheets of 21 to 24 w.g., £12 5s. to £12 10s., and of 26 w.g., £13 5s. to £13 10s. per ton. It is hoped that the demand will pick up on the new reduction. Makers of galvanised sheets have generally been successful in maintaining the recent price advance, values ranging from £16 to £16 5s., although the volume of business is insufficient to employ the local plant, of which a considerable proportion continues idle. It is satisfactory in this connection that exports of galvanised iron continue to increase steadily. The total for the five months ending last month is officially returned at 303,000 tons, as against 61,780 tons in the first five months of last year. The best markets at date are Australia, India, the Argentine, and South Africa, though this last is greatly below its usual level.

Manufactured Iron.

Business in manufactured iron at date is quiet, the demand being small all round. Makers of best class iron are the better employed, securing a fair amount of business at £13 10s. Best class merchant iron is still quoted at from £11 to £11 10s. Nut and bolt manufacturers are only buying in small quantities to carry them through the slack season. Prices of this class of iron are about stationary, production costs preventing further concessions. Belgian shippers are now asking £8 15s. for nut and bolt quality bars delivered in this district. That figure is more than £1 below the price the home maker is asking, or is prepared to accept, but when facilities and adaptability are concerned, the difference is discounted. Belgian makers, therefore, are not securing much of the meagre business which is passing.

Dearer Melting Scrap.

A satisfactory market feature at date is the interest now being taken in melting scrap, fairly heavy lots of wrought iron scrap having been sold to Staffordshire ironworks, with the result that this material has become a few shillings dearer.

Electric Railway Rolling Stock.

It is stated that three Midland rolling stock firms are concerned in a keen and interesting competition in electric railway rolling stock design and construction for the London tube railways. The London Electric Railway Company has, it is reported, placed contracts with five of the principal rolling stock manufacturers of the kingdom, three of whom are in the Birmingham district, for the design and building of a sample electric passenger coach of all-steel construction and embodying fire-resisting and safety appliances, for experimental service. The designers, it is understood, have been allowed considerable scope for the incorporation of innovations calculated to provide economy in operation and maintenance. If the new type of vehicle falls to Birmingham to construct in bulk, it should be of considerable advantage to local trade.

LANCASHIRE.

(*From our own Correspondents.*)

Manchester, Thursday.

General Outlook.

The markets for iron, steel and the non-ferrous metals are still in a more or less comatose state here, and the volume of business now passing seems to be smaller than ever. The condition of trade—so far as activity is concerned—can be fairly well gauged by a glance round the Manchester Exchange at the time of "High Change." The attendance is nothing like what it used to be, and the members seem to be engaged mostly in idle chat. A few merchants report a fair amount of business, but it is certain that the merchant trade generally is in a very poor way. One reason for this is the practical disappearance of forward buying, which, in the old days, gave the merchant some opportunity of exercising his knowledge of the markets. Just now, consumers of iron and metals are in the habit of buying what they want for immediate needs, and leaving the future to take care of itself. "Take no thought for to-morrow" seems to be the general motto of business to-day, and it means that the day of small things is with us. The utter uncertainty of the outlook is no doubt a main reason for this state of trade.

Metals.

It is said that there has been a little more local buying of copper lately, but one finds it difficult to get any satisfactory confirmation of this. One man, here and there, may have been doing more, and creating the impression that more is being done, but one doubts whether the aggregate of business in copper has been increased in the Lancashire district. The slight rise in standard which took place recently may have induced a few people to buy refined ingot, but as the price of refined ingot was not raised, it is scarcely likely that there has been very much buying. The orders recently taken for locomotives will, of course, lead later on to orders for copper and brass, but it is natural for the consumer to postpone the buying of the manufactured metals as long as possible, in the expectation that the prices will soon become more reasonable. It is not expected that refined copper will be much, if any, cheaper; but when an engineer is asked to pay 1s. 2d. per lb. for brazed brass tubes, he will naturally

refuse to pay so absurd a price until he is absolutely forced to do so. Even the more moderate—or shall we say the less immoderate?—price of 11¼d. per lb. for solid-drawn locomotive tubes acts as a deterrent when ingot brass is openly quoted at from £42 to £45 per ton. There seems to be an idea that the settlement of the coal strike in America will stimulate the demand there for copper, and that as the supply of scrap in that country is now considerably reduced, there will be a much larger consumption of new metal. It may be so, but one doubts whether American industries will recover very quickly from the effects of the coal strike. Fuel will be scarce and dear in America for some time, and perhaps throughout the winter. The demand in tin is also expected to be better for the same reason, and some improvement in the price has taken place in the East, in anticipation; but tin consumption is largely affected by the scarcity of steel sheets, and this cannot be removed immediately, even if there were a full supply of fuel. Tin has been rather a firmer market here, but the industrial demand does not appear to be very active yet. The market for lead remains steady, and rather firm, and as the forward price is now not so very much below that for prompt lead, it may perhaps be assumed that there is no immediate fear of a collapse in prices. The supply of Mexican lead is increasing, but a much larger supply of Australian lead is wanted to bring the prices down. Spelter remains quite a strong market, and although there does not now seem to be any anticipation of a further sharp advance, the supply and demand are fairly balanced in this country, and steady prices seem to be probable in the near future. The galvanisers appear to be doing fairly well of late.

Pig Iron.

The market for foundry iron in Manchester is very quiet, and the buying by the ironfounders seems to be less than it was, but as there is practically no iron other than Derbyshire to be had here—unless it be a little Northamptonshire—there may be enough consumption to keep the few furnaces clear. The price, at any rate, remains steady round about 90s. per ton delivered, and there does not seem to be any immediate probability of a fall, at any rate in this district. The great irregularities in pig iron prices continue, and we find hematite iron being sold on the East Coast at 6s. per ton less than No. 1 common iron, and at only about 1s. more than No. 3. At the present moment, hematite iron is comparatively the cheapest in the country and Scotch iron is the dearest. The Cleveland price for No. 3 hesitates round about 87s. per ton on trucks, but as it is from 5s. to 7s. dearer than other pig iron of the same class, the chances seem to be in favour of lower prices in the near future. Cleveland iron is, however, more favourably situated for shipment than the other irons.

Finished Steel.

The market here is very quiet for manufactured steel, and the reports of a better state of things which come from other districts are received with some scepticism; but it must be admitted that the Midland makers are endeavouring to keep prices from falling any more, and as a general rule one may perhaps say that manufactured steel is 10s. dearer in the Midland district than it is elsewhere. The orders coming in are still of a retail character, and hence perhaps we do not get an opportunity of seeing what sort of prices would be quoted for large orders.

Scrap.

The state of the market for scrap material shows very little alteration, and there is as yet no indication of returning life. The foundries are buying very sparingly of cast scrap, probably because they have but little work to do, and dealers are quoting from 75s. per ton for ordinary good cast scrap up to 85s. for very fine lots. The malleable ironworks are still offering only 70s. per ton for good heavy wrought scrap. Steel scrap remains almost unsaleable, nominally at 50s. per ton.

BARROW-IN-FURNESS, Thursday.

Hematite.

There is nothing much that is new to report this week in the hematite pig iron trade of this district. Business, taking it all round, continues to be of small proportions, but the bright spot is the demand on the part of local steel makers. With the steel plant at Barrow and at Workington in operation, there is a fairly good consumption of metal. There are, however, only nine furnaces in operation, and the supply is quite equal to the demand, and from present appearances it is not likely that additional furnaces will be got to work until the year is well advanced, for smelters hold some fairly heavy stores of iron and want to see them cleared. The business being done on general home account is limited, and the trade coming forward is just to cover prompt wants. Orders are held to a small extent on continental account.

Iron Ore.

With so few furnaces in operation, the demand for hematite iron ore is limited, for the trade is almost wholly confined to the district. Parcels are now and again sent away, but the tonnage is only small. During last week operations were resumed at the Newton Mines, near Barrow. A fair amount of ore is now being raised from the Hodbarrow Mines, but many pits in Cumberland remain closed down. The importations of ore from Spain and North Africa are quiet at present.

Steel.

There are no new features to report this week in the steel trades. At Workington and at Barrow the rail mills are pretty busy on orders for India, the Colonies, and to a small extent on home account. The demand, however, is small, and it is not expected there will be life, at least in the home demand, until the railway amalgamations are carried through and a new policy adopted. There is nothing being done in shipbuilding material. The Barrow Hoop Works are well employed, the orders including a contract on overseas account. The foundries are only fairly well employed.

Shipbuilding and Engineering.

These trades got to work again on Tuesday, after a longer holiday than usual. There is very little shipbuilding work in hand. Some of the engineering departments are engaged on general work, but marine jobs are very slack. There is no demand for new tonnage at present.

SHEFFIELD.

(*From our own Correspondent.*)

Still Waiting.

THERE is unfortunately very little change perceptible in the industrial situation locally. The number of men registered as unemployed remains in the region of 40,000, and one hears of only an occasional order being booked for anything beyond the small supplies required by steel trade customers in their day-to-day method of carrying on business which has now been practised now for many months past. There is no buying in expectation of a coming boom, and stocks seem to be kept at the minimum. There is an impression that during September lower wage and other costs will cheapen production to a degree that will encourage somewhat freer buying, but it would be unsafe to place too much reliance on these expectations, for it may once again be a case of the wish being father to the thought. Up to the present no considerable orders have reached Sheffield from the firms who recently obtained some very satisfactory contracts for locomotive building, for which there is no doubt they will have to take a fair proportion of Sheffield steel and certain components, such as axles and tires. This will bring more work for the local rolling mills, many of which, indeed, are just beginning to be a little more continuously, and, therefore, remuneratively employed. No local firms have, however, obtained any of the contracts for the building of these locomotives.

Experimental Coaches for London Electric.

Some little satisfaction has, however, been felt at the fact that two companies with which Sheffield has close connections are among the five which have been entrusted with orders for the design and building of a sample electric passenger coach of all-steel construction, for experimental service on the London Electric Railways. Cammell Laird and Co. is one of these companies, though the constructional work will doubtless be carried out at the firm's Nottingham works, which were completed about a year ago, primarily for railway carriage construction. Another company which has one of the contracts, the Metropolitan Carriage, Wagon and Finance Company, is one of the subsidiaries of Vickers Limited, who own practically all the share capital. In these two cases Sheffield will doubtless share in the work provided. Vickers and one or two other big local concerns have recently been extending the electrical side of their works in anticipation of the many great electrification schemes that are likely to be undertaken in all parts of the world in the near future. So far, however, little has come their way beyond the million pounds contract obtained by Vickers in connection with the electrification of the South African railways.

High Grade Steels Neglected.

Any improvement there may be in the steel trade is practically restricted to the basic and cheaper grades. Acid steel is meeting with very little demand and the high-speed and other special steels for engineers' tools will not, of course, be wanted until there is a revival in the engineering industry. The serious competition Sheffield steel makers have of late been experiencing from the Lincolnshire furnaces has, if anything, intensified, with the result that Sheffield soft billets have been reduced by 5s. to £7 5s., but this is still dearer than Lincolnshire makers can deliver similar steel in Sheffield. The quietness in the acid steel market is, of course, reflected in that for hematite iron, of which Sheffield has been taking little for some time past. Large stocks of mixed hematite have accumulated, and the material is now delivered in Sheffield at prices which have been brought down by keen competition to the remarkably low level of £5. The scrap market is still fairly active, and prices have not eased to the extent steel makers would like. It is hoped that the breaking up of a number of battleships now in progress may result in supplies being offered in such quantity as will bring down prices.

Bounty-fed versus British Steel.

Another handicap with which British steel makers are now faced is the proposal of the Parliament of the Union of South Africa to grant a bounty for iron and steel produced within the Union. The bounties will extend over eight years and, beginning at 15s. per ton, will be graded downwards, until in the last year it will be only 2s. 6d. per ton. Only works with a minimum capacity of 50,000 tons per annum will be entitled to receive the bounty. Such a policy cannot fail to greatly stimulate the production of iron and steel within the Union, and, added to the handicap already suffered by importers in the shape of the import duty, it will probably prove a disastrous blow to those British manufacturers who have hitherto looked to South Africa as a market. On the other side, the passing of the prohibitive tariff Bill by the United States Legislature will probably keep out British special steels, while the markets nearer home are for all practical purposes closed by the operation of the exchange against us. The outlook for British steel is, therefore, anything but bright, and it is not surprising to find that the spirit of pessimism is rapidly spreading in Sheffield.

Lighter Trades.

Nor is the outlook in the "lighter" trades—tool and implement makers, cutlery, silver and plate—any more encouraging. Orders in certain departments are, perhaps, a little more numerous, but they are almost invariably for small quantities, and many of the factories are closed or working short time. Inquiries from the Colonies are said to be somewhat better, but it is to be feared that Sheffield's chances will not be improved by the removal of the embargo on German goods entering Australia. The saw and file makers are now suffering a spell of inactivity after a fairly prosperous time, and the agricultural implement firms, who, on the whole, have not had much to complain of during the past season, now have plenty of time to make plans for next year's trade. The motor car industry is making very little call on Sheffield's resources, and the cessation of shipbuilding has not been counterbalanced by the placing of the comparatively small orders in connection with the all-steel aeroplanes of which so much has been heard of late. True, this industry may develop into one of considerable dimensions, but it does not seem as if that time was yet within realisation. Generally speaking, it must be confessed that Sheffield manufacturers have made singularly little effort to find alternative uses for their plant, providing primarily, it is true, for producing armament in various forms, but one would have thought that it was adaptable to a greater variety of peace time applications than has so far been evidenced.

NORTH OF ENGLAND.

(*From our own Correspondent.*)

The Trade Position.

THERE is as yet little room for encouragement in the general trade position of the North of England. The element of uncertainty, which has so long been a feature, still prevails, and what one longs to see is more definiteness in the outlook. Since the beginning of August the ordinary course of business has been interrupted, owing to the holidays in the various districts, and when these are over it is confidently believed that there will be a marked improvement in trade. At all events, a more hopeful view of the outlook is being taken by commercial people. The most satisfactory feature at the moment is the boom in the coal trade. All the collieries are actively employed. An arrangement has been arrived at whereby the trimmers and teemers will work an extra two hours per day. This is expected to ease the dislocation and expedite the shipment of coals, and thus help to augment the output at the pits, also to ensure the dispatch of steamers more expeditiously than has been the case for some time past. If this temporary settlement can be supplemented by the early substitution of an extra shift of trimmers, matters will move along much more smoothly and successfully than hitherto.

Cleveland Iron Trade.

Holiday influences have interfered with the ordinary course of events in the Cleveland iron trade. All the local steel works are closed for the week, but the blast-furnaces are being kept in operation, and it is inevitable that the stocks of pig iron—already large—will increase. Producers, however, are inclined to take a rather more hopeful view of the outlook, and are looking forward for a strong autumn demand to effect a rapid reduction in their stocks. There can be no question of putting more blast-furnaces into operation until some of these stocks are liquidated. Makers are not disposed to increase production until they can see a market for the iron, but several firms are anxious to do so as soon as possible, as it is much cheaper to operate two or more blast-furnaces than to work them singly, owing to the heavy establishment charges. A little more pig iron has been sold to America. The parcels disposed of for Atlantic shipment include hematite as well as special iron regularly purchased by the United States. Continental business of any moment, especially with Germany, is out of the question for the time being, owing to the chaotic state of the money market in that country. Home sales are also within narrow limits, and trade with Scotland is being held back by the comparative cheapness of Midland iron, which is being bought by customers beyond the Tweed in preference to the dearer Cleveland iron. Local makers, however, show no disposition to cut their prices, and nothing below 87s. is quoted for No. 3 Cleveland G.M.B., and for No. 1 buyers have to pay 95s. per ton, if they can get any at all. For No. 4 foundry 86s. per ton is quoted, though possibly that figure and also 84s. for for No. 4 forge might be shaded. Mottled and white iron are about 80s. per ton.

Hematite Pig Iron.

The position in the East Coast hematite pig iron trade is showing signs of improvement. The demand all round is better, and a big expansion is expected after the holidays are over. Mixed numbers are still offered at 89s., and a fair amount has changed hands round this figure, but some makers adhere to 90s., and ask 6d. premium for No. 1 quality.

Iron-making Materials.

Transactions are extremely few in the foreign ore trade. Best Rubio ore is still offered at 24s. 6d. per ton c.i.f. Tees. It appears that on unexpired portions of their contracts coke consumers are being given the advantage of a saving of about 5d. per ton, owing to the reduction in railway rates, and new business is being done at a lower figure. Thus, good Durham blast-furnace coke has been sold as low as 26s. per ton delivered at the works, although others quote up to 26s. 6d.

Manufactured Iron and Steel.

There is still considerable confusion in the manufactured iron and steel trade so far as values are concerned, as a result of the withdrawal of price restrictions. Quotations are down, but to nothing like the extent some customers anticipated. Manufacturers declare

that the orders they are booking have little or no margin of profit. In one or two branches inquiries are improving, and producers are encouraged to look for rather considerable expansion of oversea trade. The general situation, however, still leaves much to be desired, and there is unfortunately reason to fear that a good deal of time must yet elapse before plant in this district is again anything like normally employed.

The Coal Trade.

The Northern coal trade is still in a very strong position. The partial settlement of the American strike has not so far had the slightest effect on the demand from the United States and Canada. Indeed, merchants on the other side of the water have wired direct to collieries, as well as merchants, asking for quotations for deliveries during the autumn. Those in a position to judge, do not think that the demand will drop to any appreciable extent until October, at any rate. Stocks in America have become very seriously depleted, and colliery owners in Northumberland and Durham anticipate that it will take three or four months to exhaust the requirements of America. The continental market is showing some signs of expansion, and orders and inquiries are now beginning to be put into circulation, but there does not appear to be much hope of the usual heavy autumn and winter contracting at the present high figures, so that continental exporters are feeling the market constantly, with a view to being ready to operate as soon as the opportune moment for purchasing is discovered. The demand for the home market shows some signs of activity, and the outlook for the autumn is better than at one time seemed probable. Best Northumberland steams are still rigidly firm for any prime or favoured sorts, while steam smalls are hardly obtainable at any price. Second steams, both screened and smalls, are also well off and firm in price. Durham coals are strong for bests and selected brands of gas and bunkers, but in all other directions there is a weakening undertone becoming apparent. There is an improved demand for coke, which is one of the symptoms of a revival in trade. Prices are firm for any class of either foundry or gas coke.

SCOTLAND.

(From our own Correspondent.)

Shipbuilding Outlook Obscure.

Opinions regarding the future of shipbuilding are conflicting. Some say that only a general trade revival is required to establish a period of activity at the yards. Others maintain that costs are still too high, and have the dropping of contracts to substantiate their opinion. Instances are not wanting of owners refusing even to consider the lowest possible tender. Owners in many cases are maintaining vessels which in earlier days would have been considered obsolete. Costs, however, are slowly but surely righting themselves. Plates are now £9 10s. per ton, but are still over £2 per ton higher than pre-war rates. Wages, again, are nearing the pre-war standard. Further, it is argued that a big improvement in trade is necessary before existing tonnage will be fully employed, and that not until such a state of affairs was accomplished would new tonnage be contemplated to any extent. One estimate has it that at least eighteen months must yet elapse before the lean period is over so far as regards the Clyde yards.

Railway Rates.

The Scottish railway companies have announced certain reductions in rates for coal traffic and dock dues. The reduction in railway rates is practically similar to the modification granted in respect of coal, coke and patent fuel for shipment or for blast-furnaces and steel works. The coalowners are dissatisfied with the concessions, which still leave Scottish rates higher than those pertaining in England and Wales. Dock dues have been reduced from 150 to 100 per cent. increase on rates in operation on December 31st, 1913. The tonnage charge for tipping coal, coke and patent fuel is to remain as at present. Coalowners are now endeavouring to get the railway rates brought into line with English and Welsh charges.

Foreign versus British Rails.

Considerable controversy has arisen over a contract for steel rails for Glasgow Corporation tramways. Tenders were asked for and British and American firms responded. The lowest tender, amounting to £15,325, came from an American firm, the lowest British offer being £18,262. The former was recommended for acceptance, but after discussion before the Tramways Committee it was agreed to refer the recommendation back in order to inquire into the American conditions of labour. Labour members contend that American steel workers are obliged to work twelve hours a day and are not allowed trade union rights, whereas in Britain the workers have an eight hours' day and recognition of their unions. Labourists therefore assert that the "fair wage" clause in Corporation contracts is not observed by American producers.

New Peat Industry.

There has recently sprung up near Airdrie a new industry, involving the utilisation for agricultural and industrial purposes of a tract of waste land. The moss lands referred to have been thoroughly drained. A large factory is now in operation for the manufacture of peat fuel and moss litter on a large scale. Light railways intersect the moss lands, and the factory is connected by sidings with the North British Railway.

Steel and Iron.

Conditions governing the Scotch steel and iron trades show little change. Plates remain in small demand, with little prospect of improvement meantime. Sectional material is doing a fair turnover, but reductions in prices are looked for. Sheets of all gauges are doing some business on export account. Bar iron makers also report a growing demand on export account. Business in pig iron is most uneven. Foundry qualities occasionally book some fair lines, but hematite is stagnant. Home markets generally are still poor in the extreme, and any forward movement is almost entirely in an export direction.

Coal Exports Still Booming.

The coal market remained very firm throughout the past week, and prices were again a turn higher. Many cargoes of round coal are still fixed for America, and the activity is expected to last some time yet, despite the settlement of the strike there. A number of steamers are loading at Glasgow Harbour, and some good consignments have gone from lower Clyde ports. The East of Scotland ports are busily engaged in the shipping of washed fuels. Good cargoes have gone from Leith to Germany and a good demand from Holland is also being dealt with. A steady turnover is also being done for Bruges and Ghent. The home market is weak in the extreme, and present prices are all against a revival. Aggregate shipments amounted to 364,340 tons, against 381,111 tons in the preceding week and 324,349 tons in the same week in 1913. Miners in Lanarkshire are breaking away from the local union in the five days a week policy, and many have already presented themselves for work on the last two Saturdays.

WALES AND ADJOINING COUNTIES.

(From our own Correspondent.)

Coal Export Conditions.

The conditions prevailing on the coal market during the past week have rather emphasised the fact that the rush for coal for the States and Canada has subsided. This does not mean that the demand has fallen away to insignificant proportions, as this is not the case. Still the Americans are not pressing to effect further purchases, though additional inquiries are coming along and a certain amount of business is being carried through for September and later delivery. In the case of Canada, there is no doubt that their needs are very urgent, and are likely to become more so in view of their own troubles with the miners. Anthracite coals are particularly in request for Canada, and it is because the quantity of these coals available is relatively smaller that the demand for them appears to be so much greater. Up to the end of last week tonnage had been chartered to lift South Wales coals to the amount of rather more than 1,156,000 tons, and with the business that firms of exporters have in hand, there is little doubt that orders already executed and those to be carried through aggregate fully one and half a million tons for America and Canada. It is interesting to note that according to the Customs returns, exports from this district last week to foreign destinations generally were close upon 600,000 tons. This was high water mark for the current year, and works out at the rate of approximately 30 million tons per annum. Reference has to be made to the pre-war period to find figures like these. The work of shipment has been got through very satisfactorily, and there have been surprisingly few real complaints regarding delays, which show that the dock authorities have tackled the question of expediting shipments and taken steps to remedy congestion. Of course, there has been detention, and will be a fair amount of it during the next few weeks, but that troubles in this respect are being reduced to a minimum is evident.

Ebbw Vale Outlook.

The position as between the Ebbw Vale company and workmen does not at the time of writing look at all promising. It will be recalled that the award of Professor Galloway regarding cutting prices for certain seams and special allowances went in favour of the company. Mass meetings of the men were held last week-end, when the speeches delivered were anything but conciliatory; rather the reverse. The advisory agent of the miners proposed that unless the company by Thursday of this week waived the award and agreed to the terms of the men, their officials should on that morning go to the Marine Colliery. No man should go down that colliery, but they should wait in silence while the men's leaders negotiated with the management. On Friday morning, the same line of action should be adopted at Waunllwyd Colliery, and if the men's grievances were not remedied it was proposed that the whole of the workmen in the district should then march to the general offices and silently demonstrate, while their leaders went inside to discuss matters with the directors. The movement was to be entirely peaceable. The mass meetings decided to adopt the policy of their advisory agent, so before the week is out it is just possible that interesting developments may take place.

Shipping and Taxation.

An instance of the crushing burden of taxation on industry is revealed in the case of the Penmark Shipping Co. of Cardiff, and largely on this account the directors and managers recommend the shareholders to pass a recommendation that the undertaking should be voluntarily wound up. This company was formed early in 1919 with an authorised capital of £100,000, of which £85,784 was subscribed. Two steamers were purchased, but one of them was sold in 1921 at about £50,000 less than the price that was paid for it. According to the managers, the company has been most successful in its trading, and up to June this year most satisfactory profits were made. However, the slump came. In addition, the burden off taxation, in particular, has been enormous. During the three years that the company has been in existence, the sum of £47,315 5s. has or will have to be paid to the Treasury. The managers have gone into the question of future taxation, and find that estimated profits will not be sufficient to meet income tax based on the average profits of the past three years. The present position is that on an immediate wind-up there is a return of approximately 14s. per share of £1 each.

Current Business

When Transatlantic business is eliminated, it is found that there is not much activity in the coal export trade, as continental inquiries are very meagre. Shipments to France on comparatively low contracts are being carried, but the fresh demand from this quarter and Italy is extremely limited, and consumers display no disposition at the moment to come up to current market values. Time, however, will in all probability effect a depletion of stocks and compel them to make new purchases. At the present time prices of steam coals show no alteration, and collieries producing the best Admiralty, decline to accept less than 31s. to 32s. 6d. for supplies for next month, and, in fact, decline to make any definite offers, as they are very full up with orders. Best smalls are also very firm and scarce, and command 23s. In the anthracite section values are higher and it is difficult in the extreme to get coals for early delivery. There is an inquiry for 50,000 to 100,000 tons of sized coal for shipment during the next three months to Canada, but with their commitments already heavy this is a big proposition for any undertaking. Best anthracite large is 62s. 6d. to 65s., and machine made nuts and cobbles range from 72s. 6d. to 75s. For prompt shipment it is almost impossible to get the offer of even a few hundred tons of the latter.

Swansea Metal Exchange.

Inquiries are in the market for tin-plates for America and Canada. The market, however, shows no material change, but is firm, as makers state that costs of production are still unremunerative.

Ebbw Vale Trouble.

The Executive of the South Wales Miners' Federation have had under consideration the dispute at Ebbw Vale, and have decided to refer the matter to the Executive of the Miners' Federation of Great Britain, with a view to further action being taken through the Ministry of Labour.

THE LINEAR ELECTRIC HEATING SYSTEM.

An interesting method of heating buildings by means of electricity is described in a publication recently issued by the Oerlikon Company. The system was employed in the first instance by a Swiss engineer, Mr. Zweifel, in a cotton mill, the heating elements being composed of iron strip attached to porcelain insulators fixed at a height of 2.5 m. above the floor level. The strip used had a section of 19 mm. by 1 mm., and was heated with a current of about 120 ampères.

It was, it is said, found possible to maintain the temperature in large buildings at 35 deg. Cent. above that of the outside atmosphere, with a consumption of 10 to 15 watts per cubic metre, whilst in the case of extensive sheds the consumption for the same temperature rise was 25 to 35 watts. A special advantage was the small variation in temperature between the various parts of the buildings. Sheds in which there had hitherto always been damp corners soon became perfectly dry.

It was, however, necessary to take into account the fact that in some countries bare heating conductors are not permitted by the fire insurance companies. Several new designs of heating elements were therefore evolved. In the first instance, the conductors were placed in sheet iron tubes, 120 mm. in diameter, but later these tubes were replaced by gas pipes and steel-armoured tubes. The insulation has to withstand very severe conditions, for although the outside temperature of the tubes may only be 80 deg., 120 deg. or 150 deg. Cent., the porcelain or other insulation may have to withstand much higher temperatures.

Heating elements have now been designed which are enclosed in 1¼in. gas pipes, which are coupled together by means of sockets, elbows, &c. Other elements which have been introduced consist of a high-grade heating wire embedded in a pliable heat-resisting mass placed in flexible metallic tubing. These flexible heating units can easily be installed, and they are claimed to be very suitable for private houses and offices. It is stated that in a bedroom with two outer walls, the temperature can be maintained at 15 deg. Cent. above the average outside temperature with a consumption of 21 watts per cubic metre. The system is said to have proved particularly advantageous in cotton spinning mills and in large warehouses, where the goods must not be frozen,

Contracts.—The Westinghouse Brake and Saxby Signal Company, Limited, of 82, York-road, King's Cross, London, N. 1, has been entrusted with a contract to provide the signalling material for 120 miles of alternating-current signalling, to be installed by the Signal Engineer of the New Zealand Government Railways. This installation is to be on the A.P.B. system, with daylight "colour-light" signals. The same company has been awarded the contract for three-position automatic signalling between Marylebone Station and Wembly Hill, on the Great Central Railway.—Daniel Adamson and Co., Limited, of Dukinfield, near Manchester, have received an order for one of their latest type electrically driven crude sewage lifting plants for Messrs. Cropper's new factory at Thatcham, Berks.—Recently the New Zealand Government placed with Vickers Limited orders for two Pelton turbines, which are now being erected on site, and followed this up by entrusting the firm with the manufacture of the two Francis turbines, each of 3100 horse-power, destined to be placed at the Hora Hora power station on the Waikato River. These machines are to operate under a 27ft. head.—The Anderson-Grice Company, Limited, of Carnoustie, has received an order from the Abertillery and District Water Board for two "Anderson" electric locomotive cranes for service in the construction of Grwyne Fawr Reservoir. The cranes will be of the three-motor type and are to lift 2 tons at 40ft. radius when free on 9ft. gauge. The motors, of 20, 20 and 5 horse-power, are to be supplied by Messrs. J. P. Hall and Co., of Oldham, and the control equipment is of British Thomson-Houston manufacture.—The Senghenydd Coal Washery in South Wales is now being remodelled by Head, Wrightson and Co., Limited, of Stockton-on-Tees, who are installing their "Nota Nos" coal washers, and also their fine dust extraction plants for a capacity of 70 to 80 tons per hour.

Current Prices for Metals and Fuels.

IRON ORE.

N.W. Coast—	
Native	22/6
(1) Spanish	22/6
(1) N. African	22/6
N.E. Coast—	
Native	—
Foreign (c.i.f.)	24/6

PIG IRON.

	Home. £ s. d.	Export. £ s. d.
(2) Scotland—		
Hematite	5 7 6	—
No. 1 Foundry	5 0 0	—
No. 3 Foundry	4 15 0	—
N.E. Coast—		
Hematite Mixed Nos.	4 9 0	4 9 0
No. 1	4 9 6	4 9 6
Cleveland—		
No. 1	4 15 0	4 15 0
Silicious Iron	4 15 0	4 15 0
No. 3 G.M.B.	4 7 6	4 7 6
No. 4 Foundry	4 6 0	4 6 0
No. 4 Forge	4 4 0	4 4 0
Mottled	4 0 0	4 0 0
White	4 0 0	4 0 0
Midlands—		
(3) Staffs.—		
All-mine (Cold Blast)	13 0 0	—
Part Mine Forge	*None offering.*	
(3) Northampton—		
Foundry Nos. 2 and 1	*Nominal.*	
,, No. 3	4 0 0	—
,, Forge	3 10 0 to 3 12 6	
(3) Derbyshire—		
No. 3 Foundry	4 1 6 to 4 2 6	
Forge	3 12 6 to 3 15 0	
(3) Lincolnshire—		
Basic	4 0 0 to 4 5 0	
Foundry	4 5 0 to 4 10 0	
Forge	4 2 6 to 4 5 0	
(4) N.W. Coast—		
N. Lancs. and Cum.		
Hematite Mixed Nos.	5 5 0	—

MANUFACTURED IRON.

	Home. £ s. d.	Export. £ s. d.
Scotland—		
Crown Bars	10 10 0	10 10 0
Best ,,	12 0 0	—
N.E. Coast—		
Crown Bars	11 0 0	—
Tees	10 10 0	—
Lancs.—		
Crown Bars	11 10 0	—
Second Quality Bars	10 5 0	—
Hoops	14 0 0	13 15 0
S. Yorks.—		
Crown Bars	12 0 0	—
Best ,,	13 0 0	—
Hoops	14 0 0	—
Midlands—		
Crown Bars	11 0 0	—
Marked Bars (Staffs.)	13 10 0	—
Nut and Bolt Bars	9 15 0 to 10 0 0	
Gas Tube Strip	11 0 0 to 11 5 0	

STEEL.

	(6) Home. £ s. d.	(7) Export. £ s. d.
(5) Scotland—		
Boiler Plates	12 10 0	—
Ship Plates ¼in. and up	9 0 0	—
Sections	8 15 0	—
Steel Sheets ⅛in. to ¼in.	10 5 0	—
Sheets (Gal. Cor. 24 B.G.)	—	17 12 6

STEEL (*continued*)

	Home. £ s. d.	Export. £ s. d.
N.E. Coast—		
Ship Plates	9 0 0	—
Angles	8 15 0	—
Boiler Plates	12 10 0	—
Joists	9 0 0	—
Heavy Rails	9 0 0	—
Fish-plates	13 10 0	—
Channels	13 10 0	—
Hard Billets	8 15 0	—
Soft Billets	7 15 0	—
N.W. Coast—		
Barrow—		
Heavy Rails	9 10 0	—
Light ,,	11 0 0 to 13 0 0	
Billets	9 5 0	—
Ship Plates	10 0 0	—
Boiler ,,	13 10 0	—
Manchester—		
Bars (Round)	9 0 0 to 9 10 0	
,, (others)	9 10 0 to 10 0 0	
Hoops (Best)	15 5 0	15 0 0
,, (Soft Steel)	12 5 0	12 0 0
Plates	9 0 0 to 10 0 0	
,, (Lancs. Boiler)	13 10 0	—
Sheffield—		
Siemens Acid Billets	10 0 0	—
Bessemer Billets	12 10 0	—
Hard Basic	8 15 0	—
Soft ,,	7 10 0	—
Hoops	12 5 0	—
Soft Wire Rods	10 0 0	—
Midlands—		
Small Rolled Bars	9 5 0 to 9 10 0	
Billets and Sheet-bars	7 5 0	—
Gas Tube Strip	10 0 0 to 10 5 0	
Sheets (20 W.G.)	11 5 0 to 11 10 0	
Galv. Sheets (f.o.b. L'pool)	16 0 0	—
Angles	9 0 0 to 9 10 0	
Joists	9 0 0 to 9 10 0	
Tees	10 0 0	—
Bridge and Tank Plates	9 0 0 to 9 10 0	

NON-FERROUS METALS.

Swansea—	
Tin-plates, I.C., 20 by 14	19/- to 19/4½
Block Tin (cash)	160 5 0
,, (three months)	160 7 6
Copper (cash)	63 10 0
,, (three months)	63 12 6
Spanish Lead (cash)	24 12 6
,, (three months)	23 15 0
Spelter (cash)	31 5 0
,, (three months)	30 7 6
Manchester—	
Copper, Best Selected Ingots	69 0 0
,, Electrolytic	71 0 0
,, Strong Sheets	94 0 0
,, Loco Tubes	0 1 1½
Brass Loco Tubes	0 0 11¾
,, Condenser	0 1 2¾
Lead, English	26 10 0
,, Foreign	25 0 0

FERRO ALLOYS.

(All prices now nominal.)

	Per Ton.	Per Unit
Tungsten Metal Powder	1/8 per lb.	
Ferro Tungsten	1/5 per lb.	
Ferro Chrome, 4 p.c. to 6 p.c. carbon	£24	10/-
,, 6 p.c. to 8 p.c. ,,	£23 10 0	9/-
,, 8 p.c. to 10 p.c. ,,	£23 10 0	8/-
,, Specially Refined		
Max. 2 p.c. carbon	£60	26/-
,, 1 p.c. ,,	£70	30/-
,, 0·75 p.c. carbon	£75	37 -
,, carbon free	1/7 per lb.	
Metallic Chromium	5/- per lb.	
Ferro Manganese (per ton)	£15 for home.	
,, Silicon, 45 p.c. to 50 p.c.	£12 10 0 scale 5/- per unit	
,, ,, 75 p.c.	23 10 0 scale 6/- per unit	
,, Vanadium	18/- per lb.	
,, Molybdenum	6/- per lb.	
,, Titanium (carbon free)	1/2 per lb.	
Nickel (per ton)	£160	
Cobalt	11/- per lb.	
Aluminium (per ton)	£82 to £100	

(British Official.)

FUELS.

SCOTLAND.

	Export.
Lanarkshire—	
(f.o.b. Glasgow)—Steam	23/-
,, ,, Ell	24/-
,, ,, Splint	24/6 to 27/6
,, ,, Trebles	23/-
,, ,, Doubles	22/-
,, ,, Singles	21/-
Ayrshire—	
(f.o.b. Ports)—Steam	23/-
,, ,, Splint	24/6
,, ,, Trebles	23/-
Fifeshire—	
(f.o.b. Methil or Burntisland)—Steam	22,6 to 25/-
Screened Navigation	30/-
Trebles	23/6
Doubles	23/-
Singles	21/-
Lothians—	
(f.o.b. Leith)—Best Steam	23/6
Secondary Steam	22/6
Trebles	23/6
Doubles	22/6
Singles	21/-

ENGLAND.

(8) N.W. Coast—	
Steams	33/-
Household	46/8 to 57/6
Coke	34/-
Northumberland—	
Best Steams	25/- to 26/-
Second Steams	23/- to 24/-
Steam Smalls	17/6 to 20/6
Unscreened	20/6
Household	25/- to 28/-
Durham—	
Best Gas	24/- to 25/-
Second	22/6 to 23/6
Household	25/- to 28/-
Foundry Coke	33/- to 35/-

Sheffield—	Inland.
S. Yorks. Best Steam Hards	21/- to 22/-
Derbyshire Hards	19/- to 20/-
Seconds	18/- to 20/-
Cobbles	17/- to 19/-
Nuts	15/- to 16/-
Washed Smalls	10/- to 11/-
Best Hard Slacks	12/- to 13/-
Seconds ,,	9/- to 10/6
Soft Nutty ,,	7/6 to 8/6
Pea ,,	7/- to 8/-
Small ,,	2/- to 4/6
House, Branch	30/- to 33/-
,, Best Silkstone	27/6 to 29/-
Blast Furnace Coke (Inland and Export)	19/- to 21/-

(9) SOUTH WALES.

Cardiff—	
Steam Coals:	
Best Smokeless Large	31/- to 32/6
Second ,, ,,	30/- to 31/-
Best Dry Large	30/- to 31/-
Ordinary Dry Large	29/- to 30/-
Best Black Vein Large	30/- to 31/-
Western Valley ,,	29/- to 30/-
Best Eastern Valley Large	27/6 to 30/-
Ordinary ,, ,,	25/- to 27/6
Best Steam Smalls	22/- to 23/-
Ordinary ,,	20/- to 21/-
Washed Nuts	28/- to 32/6
No. 3 Rhondda Large	29/- to 30/-
,, ,, Smalls	22/- to 23/-
No. 2 ,, Large	24/- to 26/-
,, ,, Through	21/- to 23/-
,, ,, Smalls	16/- to 17/6
Coke (export)	40/- to 45/-
Patent Fuel	27/6 to 30/-
Pitwood (ex ship)	35/6 to 36/6
Swansea—	
Anthracite Coals:	
Best Big Vein Large	62/6 to 65/-
Seconds	55/- to 60/-
Red Vein	52/6 to 55/-
Machine-made Cobbles	72/6 to 75/-
Nuts	72/6 to 75/-
Beans	42/6 to 45/-
Peas	24/- to 25/-
Breaker Duff	8/6 to 9/-
Rubbly Culm	15/6 to 16/6
Steam Coals:	
Large	21/6 to 23/-
Seconds	20/- to 22/-
Smalls	14/6 to 16/-
Cargo Through	19/6 to 20/6

(1) Delivered. (2) Net Makers' works. (3) At furnaces. (4) Delivered Sheffield. (5) Glasgow, Lanarkshire and Ayrshire.

(6) Home Prices—All delivered Glasgow Station. Boiler Plates 10/- extra delivered England (7) Export Prices—F.O.B. Glasgow.

(8) Except where otherwise indicated coals are per ton at pit for inland and f.o.b. for export and coke is per ton on rail at ovens and f.o.b for export. (9) Per ton f.o.b.

French Engineering Notes.

(From our Correspondent in Paris.)

Currency and Trade.

The failure of the London Conference was followed by a rapid fall in the value of the franc, and while the drop was soon arrested and was followed by a sharp recovery, the net result, as usual, is a permanent depreciation. The belief that low currency values helps business by cheapening production has not been justified in this country, for, while costs tend eventually to adjust themselves to the lower values, the temporary advantages from the manufacturers' point of view pending the adjustment are lost by the special tariffs imposed by certain foreign markets on goods from countries with a depreciated currency. At home the fall of the franc has no influence at all in stimulating business. On the contrary, the engineering industry is so closely associated with finance that when the situation weakens confidence amongst financial people, it affects the manufacturing trades as well. Every event, such as the London Conference, which drives the franc back a point or two is regarded by business people with considerable uneasiness, because it means that anything in the way of new business enterprise is entirely arrested. Confidence is accurately reflected in the exchange rate, and it can only revive with a gradual improvement in the franc until it comes back to somewhere near its normal figure. A too rapid improvement would cause as much economic trouble as a collapse. Nevertheless, the situation is probably better than it is in other countries with a depreciated currency. One reason for this is the enormous potential wealth represented by the natural resources, and another is the number of public works which are being carried out for the development of that wealth. The execution of those works is being hindered by the difficulty of procuring the necessary funds, but enough is being done to provide employment to nearly all the engineering concerns, which are able to keep going without finding themselves overburdened with orders. The situation is precarious because manufacturers can never see far ahead, except the enormous amount of work that is waiting to be distributed as soon as the country's finances will permit of a sufficiently large expenditure of money. As the state of the national finances is reflected in the value of the franc, any further depreciation necessarily narrows down the prospects of an early recovery. The position is, nevertheless, strengthened by the fact that the country is not suffering from unemployment. If anything, there is insufficient skilled labour, owing partly to the considerable number of men who have been drafted into the devastated regions by the offer of higher wages, and the increased pay thus held out by the State Departments as an inducement to men to migrate into the devastated areas is even alleged to be one of the factors of the high wages which employers are obliged to pay elsewhere.

Industrial Investments.

The complaint that capital is not available for industrial enterprises is perfectly justified so far as concerns the participation of financial houses which have entirely withdrawn their support as the result, partly, of their unfortunate experience in this direction during the past three or four years. At one time the banks were rather too eager to finance industrial undertakings, and now the pendulum has swung the other way. Nevertheless, returns of investments during the first six months of the present year show that the general public has been subscribing enormous sums of money to State issues and to the big metallurgical and other groups which raised loans under State guarantee. The total amount for the six months was 8248 million francs, as compared with a little less than 5000 million francs in the first half of 1921. More than one-half of the amount was lent to the State. For reconstruction work guaranteed by the State, the amount subscribed was 1251 million francs. Then followed 511 millions for electrical engineering, 299 millions for metallurgical concerns, 134 millions for oil companies, and 126 millions for coal companies.

Gliders.

The competition of gliders at Combegrasse, near Clermont-Ferrand, has continued to give negative results, and the best that can be said of them is that they may serve as a training for aeroplane pilots, but in view of the serious accidents that have taken place, it is evident that the use of gliders for training purposes must be depreciated. One competitor started from the hill in the teeth of a strong wind and, losing speed, slipped over and dived to the ground. Two men sustained dangerous injuries in this way, while others had narrow escapes. The trouble is that all the machines so far tried are simply gliders, and none has been able to navigate in the air, that is to say, employ the energy provided by the air currents for rising and manœuvring. The problem is too abstruse to be solved by indiscriminate experiment. The form of energy it is sought to utilise is essentially variable, and once in the air the pilot has no means of accurately judging its strength and direction, while he must possess a skill in adjusting his plane to the wind currents that is almost equivalent to a sixth sense. The only hope lies in a form of plane that will automatically adapt its incidence to varying wind pressures.

Liquid Fuel.

The necessity of fixing upon a uniform nomenclature of liquid fuels so as to provide an exact rendering in different languages, with correct definitions of their chemical and physical properties, has suggested the holding of a Congress in Paris, from October 9th to 15th. It will be under the presidency of M. Paul Sabatier, Member of the Institute and Doyen of the Faculty of Sciences at Toulouse, and practically all the leading chemists and scientists have given their support. The discussion will not only cover liquid fuels such as petroleum, benzol, alcohol and vegetable oils, but also lignites, peat, and tar. The Congress will investigate the methods and apparatus employed for analysis, research and verification, and will, in a word, collect all possible data for classification, so that the engineer and user may know exactly what they are dealing with.

British Patent Specifications.

When an invention is communicated from abroad the name and address of the communicator are printed in italics.

When an abridgment is not illustrated the Specification is without drawings.

Copies of Specifications may be obtained at the Patent Office Sale Branch, 25, Southampton-buildings, Chancery-lane, W.C., at 1s. each.

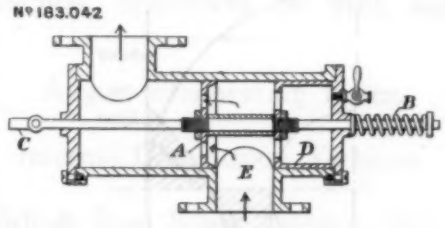
The date first given is the date of application; the second date, at the end of the abridgment, is the date of the acceptance of the complete Specification.

STEAM ENGINES.

183,042. July 27th, 1921.—Governors, A. J. Roberts, Bedford Hotel, Southampton-row, London, W.C.

The inventor proposes to control the racing of marine engines by utilising the exhaust pressure to regulate the main throttle. The exhaust passes through a casing, as shown by the arrows, and does not normally exert sufficient pressure on the perforated piston A to overcome the spring B. If the engine races, the volume of steam which has to pass through the apertures

N° 183,042.



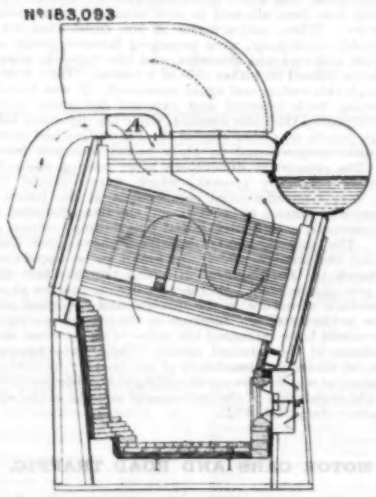
in A is so great that the piston is moved to the left, and in so doing operates the throttle through the linkage C. At the same time the piston valve D is drawn across the port E, and partially obstructs the exhaust, with the result that the pressure on A is relieved and the spring B brings the throttle back to the normal position.—*July 20th*, 1922.

STEAM GENERATORS.

183,093. January 6th, 1922.—Waste Heat Boilers, Babcock and Wilcox, Limited, and A. Speyer, 30, Farringdon-street, London, E.C.

This specification covers the introduction of the exhaust gases from internal combustion engines into oil-fired water-tube boilers for the purpose of assisting in the generation of steam.

N° 183,093.



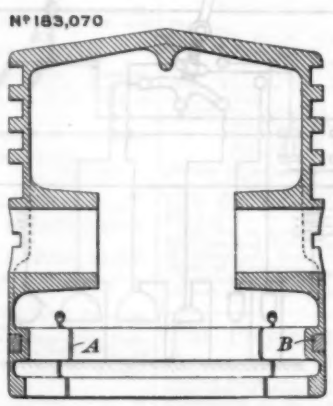
The illustration shows the exhaust gases introduced at A and led into the second pass of the boiler, but alternatives are suggested where the gases are brought in at other passes.—*July 20th*, 1922.

INTERNAL COMBUSTION ENGINES.

183,070. September 20th, 1921.—Aluminium Pistons, E. C. S. Clench, The Aster Engineering Company (1913), Limited, Wembley, Middlesex.

The inventor proposes to overcome the difficulty of preventing aluminium pistons "slapping" in the cylinders, whilst providing sufficient clearance to allow for expansion, by splitting the skirt of the piston, as shown at A, and inserting a split

N° 183,070.

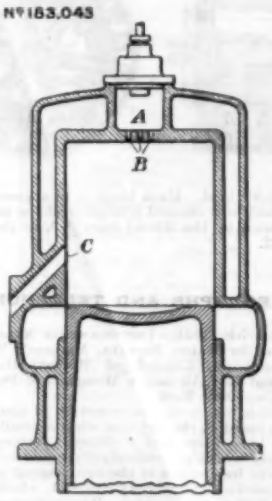


cast iron ring B, which bottoms in its groove. The ring and the piston in its vicinity are of such a diameter that they both have to be compressed before they will enter the cylinder.—*July 20th*, 1922.

183,043. July 29th, 1921.—Combustion Chambers for Two-stroke Engines, *B. E. D. Kilburn*, 31–33, *High Holborn, London, W.C.* 1.

In this engine an effort is made to improve the combustion of the working charge by introducing it through a chamber A, auxiliary to the cylinder. The fuel is sprayed into the chamber without mixing with atomising air. After a part of the fuel has been ignited in the chamber, the rest of the fuel, in consequence of the increased pressure caused thereby, mixes with hot combustion gases and is forced through the openings B into the

N° 183,043.



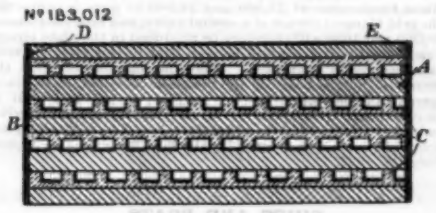
working cylinder, where the combustion proceeds satisfactorily owing to the presence of oxygen there. Pre-compressed pure air is introduced through the conduit C, which discharges into the working cylinder at a suitable point. Instead of the conduit C, an opening provided with a valve may be employed. The pressure will be low if the additional air begins to enter during the scavenging period, but will be higher if the air enters at a later stage.—*July 20th*, 1922.

BATTERIES AND ACCUMULATORS.

183,012. May 25th, 1921.—Improvements relating to Secondary Batteries or Accumulators, Benjamin Heap and the Chloride Electrical Storage Company, both of Clifton Junction, near Manchester.

The object of this invention is to prevent short circuits occurring in accumulators, owing to the presence of sediment or solid particles at the plate edges, and also to prevent relative movement of the plates and separators, and to obviate the necessity for providing a mud space beneath the plates. The positive

N° 183,012.



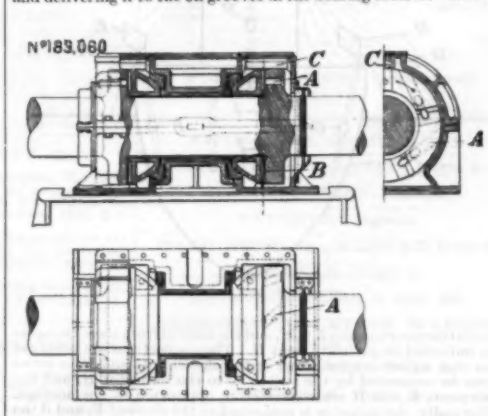
plates A are separated from the negative plates B by grooved or ribbed separators C. The plates have their sides, and if desired their bottoms, cemented together with bitumen or other acid-resisting insulating material D, and if necessary a celluloid sheet E may be applied to the cementing material, to facilitate the insertion of the plates into the case. To remove any solid matter which may accumulate in the group of plates, the cell may be inverted, and the solid matter poured off with the electrolyte.—*July 20th*, 1922.

TRANSMISSION OF POWER.

183,060. August 22nd, 1921.—Thrust Bearings, R. T. Clarke, Mayfield, Ailsa-road, St. Margarets, Twickenham.

The principal claim in this specification is for the provision of the passages A A, arranged in a tangential direction, for scooping up oil from the oil wells in the base of the pedestal, and delivering it to the oil grooves in the bearing faces B. There

N° 183,060.

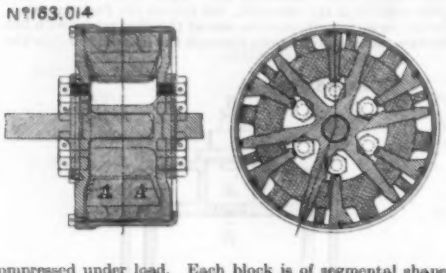


are two collars for taking up the thrust when going ahead and when going astern, and the oil passages are naturally sloped in opposite directions in the two collars. The scraper C takes oil

off the collar and leads it to the central journal bearing.—*July 20th*, 1922.

183,014. May 26th, 1921.—Resilient Couplings, G. Spencer Moulton and Co., Limited, 2, Central-buildings, Westminster, and J. W. Cross, Newlands, Ditton-hill, Surbiton.

It appears that the important claim in this specification concerns the shape of the rubber blocks A A, used to transmit torque from one-half of the coupling to the other, which are under initial stress when idle and are free to expand when further

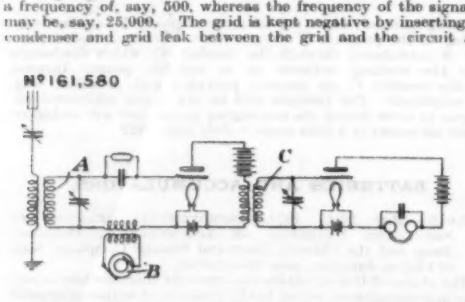


compressed under load. Each block is of segmental shape in cross section and of truncated triangular shape in longitudinal section, as shown by the dotted lines A A in the drawing.—*July 20th*, 1922.

TELEGRAPHS AND TELEPHONES.

161,580. April 7th, 1921.—Improvements relating to the Reception of Radio Signals, Marconi's Wireless Telegraph Company, Limited, of Marconi House, Strand, W.C. 2, and Roy Alexander Weagant, of Douglas Manor, Queen's City, New York.

This invention relates to the reception of continuous wave signals, and is based on the fact that when an oscillating current is modulated by a current of a different frequency, two frequencies appear which are respectively equal to the sum and difference of the frequencies of the two original currents. The antenna is coupled to an oscillatory circuit A, which is connected to the grid and filament of a valve. B is an alternator producing a frequency of, say, 500, whereas the frequency of the signals may be, say, 25,000. The grid is kept negative by inserting a condenser and grid leak between the grid and the circuit A.

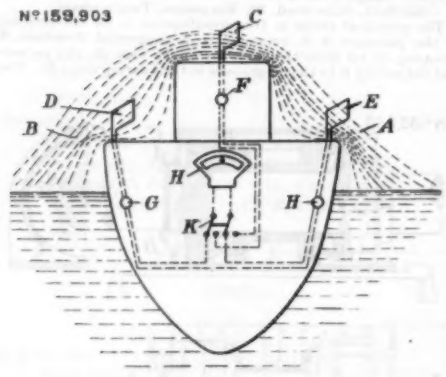


In the plate circuit intermediate frequencies of, say, 25,500 and 24,500 will be developed. Coupled to the plate circuit is an oscillatory circuit C, which is tuned to the frequency of the signals, *i.e.*, 25,000. This circuit, which will allow the intermediate frequencies of 25,500 and 24,500 to pass is connected to the grid filament circuit of a second valve, and final frequencies of 50,000 and 1000 will therefore be produced in the plate circuit of this second valve. It will be seen that in this circuit a telephone receiver is connected. When no signals act upon the antenna, nothing is heard in the telephone receiver, as the local frequency of 500 cannot set up oscillations in the circuit C, since it is tuned to a frequency of 25,000, but when signals arrive, sounds due to the 1000 frequency are heard in the telephone, which is, of course, unaffected by the final frequency of 50,000. —*July 7th*, 1922.

SHIPS AND BOATS.

159,903. March 9th, 1921.—Differential Method and Device for the Electrical Navigation of Ships, Signal Gesellschaft m.b.H., of Werk, Keil, Germany.

This invention relates to a device for use on ships for navigating under the control of alternating-current cables. The dotted lines shown in the illustration represent the magnetic lines of the navigating alternating current. When the cable is on the right of the ship, the lines are more dense at the point A than at the point B. It will be seen that there are three conducting loops, and the loop C, which is mounted on the bridge, is in a position where the density of the lines is greatest. This loop is only used for observation, whilst the other two loops D and E on the port and starboard are used for determining the position of the ship relatively to the cable. All the loops are connected

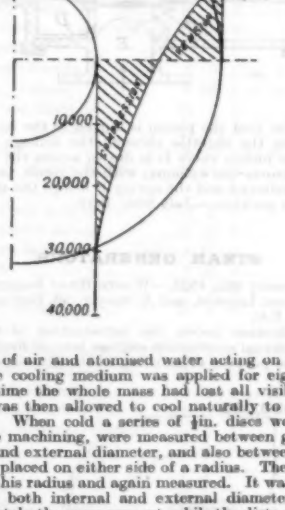


with thermo-elements F G H, and the current from these elements is indicated on an instrument H. The connections are arranged so that either element alone or the elements G and H in series can be connected by the switch K to the indicator H, and the elements G and H are connected in opposition to one another. Normally, the indicator is connected to the element F, and if the element is found to give a current, a connection is made to the elements G and H, and the direction of the current gives an indication relative to the position of the ship in respect to the cable.—*July 10th*, 1922.

ORDNANCE AND ARMOUR.

183,267. April 26th, 1921.—Cylinders for Withstanding High Internal Pressures, C. P. Sandberg and J. C. W. Humphrey, 40, Grosvenor-gardens, London, S.W. 1.

This invention is concerned with the production of cylinders, such as gun barrels, which have to withstand considerable internal pressures, and is practically concentrated within the following quotation :—"The whole cylinder is heated to a temperature above that of the critical range, and then the interior is cooled at a more rapid rate than the exterior ; for instance, by means of blasts of air, air and atomised water or other elastic fluid, the rate of cooling through the critical range being insufficiently rapid to produce hard or martensitic structure in any part of the cylinder. In this manner, not only does the effect of the difference in the rate of thermal contraction come into play as in the known process, but also the effect of the volume change due to difference of structure, the two effects being additive in result in respect of increasing the resistance of the cylinder to internal pressure." The following is given as an example of the kind of result attainable by the invention :—A cylindrical forging of steel containing 0.48 per cent. carbon, 0.55 per cent. manganese, of 5in. external diameter and 2in. internal diameter, was heated to 850 deg. Cent. and then cooled by means of a

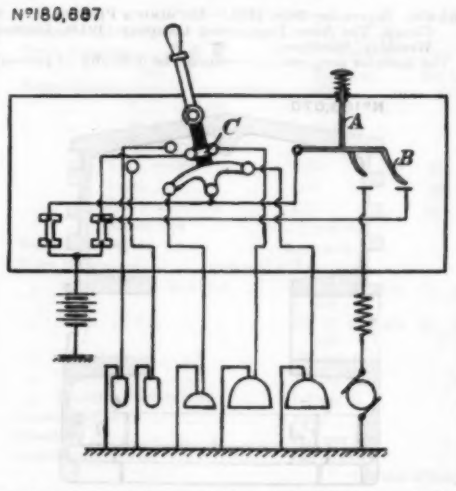


series of jets of air and atomised water acting on the internal surface. The cooling medium was applied for eight minutes, after which time the whole mass had lost all visible redness ; the forging was then allowed to cool naturally to atmospheric temperature. When cold a series of ¼in. discs were cut and, after suitable machining, were measured between gauge marks for internal and external diameter, and also between a series of gauge marks placed on either side of a radius. They were then cut through this radius and again measured. It was found that after cutting both internal and external diameters increased by approximately the same amount, while the distances between the gauge points on either side of the cut radius had increased by amounts proportional to their radial distance from the centre. The change in dimensions after cutting showed that the stresses originally present, which were relieved by the cutting, were circumferential compression in the interior and circumferential tension in the exterior, the stress forming a pure bending moment across each radial longitudinal section of the forging. The measurements described above give data for calculating the stresses which are found to be approximately those shown in the diagram, in which the numbers express pounds per square inch. Microscopical examination showed a partly sorbitic structure in the interior and a normal pearlitic structure in the exterior. Increase in the rate of cooling of the cylinder would have increased the value of the stresses and also the hardness of the internal metal. These two changes can, however, be varied independently of one another by varying the temperature at which more rapid cooling of the interior is stopped and by the regulation of the subsequent cooling of the cylinder as a whole.—*July 26th*, 1922.

MOTOR CARS AND ROAD TRAFFIC.

180,687. May 26th, 1922.—Improvements in Electric Lighting and Starting Installations for Motor Vehicles, Robert Bosch Aktiengesellschaft, of 4, Militarstrasse, Stuttgart, Germany.

The connections for the starting and lighting of motor cars are arranged in accordance with this invention, so that only two fuses are provided for the entire installation. The same battery serves for starting and lighting the vehicle, and when

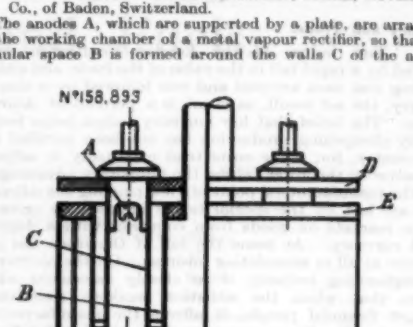


the pedal switch A is depressed, the contact B first connects the fuses in parallel, whilst when the pedal switch is further depressed current is supplied to the motor. The switch C controls the various lamps.—*July 20th*, 1922.

MISCELLANEOUS.

158,893. July 7th, 1922.—Improvements in Apparatus for Cooling Metal Vapour Rectifiers, Brown, Boveri and Co., of Baden, Switzerland.

The anodes A, which are supported by a plate, are arranged in the working chamber of a metal vapour rectifier, so that an annular space B is formed around the walls C of the anode



sleeves, in order that a cooling medium may circulate through the free space formed between the anode-supporting plate D and the cover plate E of the working chamber.—*July 7th*, 1922.

Forthcoming Engagements.

Secretaries of Institutions, Societies, &c., desirous of having notices of meetings inserted in this column, are requested to note that, in order to make sure of its insertion, the necessary information should reach this office on, or before, the morning of the Wednesday of the week preceding the meetings. In all cases the time and place *at which the meeting is to be held should be clearly stated.*

TUESDAY to FRIDAY, SEPTEMBER 5th to 8th.

Iron and Steel Institute.—Autumn meeting at York. For programme see page 96.

WEDNESDAY, SEPTEMBER 13th.

The Institution of Locomotive Engineers : Manchester Centre.—Visit to the carriage and wagon works of the Great Central Railway at Dukinfield. Members will meet at London-road Station, G.C.R., and leave by special train at 2.30 p.m.

WEDNESDAY to FRIDAY, SEPTEMBER 20th to 22nd.

The Institute of Metals.—Swansea. Annual autumn meeting. For Programme see page 152.

PERSONAL AND BUSINESS ANNOUNCEMENTS.

The West Kent Works, Limited, of Westerham, was awarded the silver medal (first prize) in the New Implement Class, at the Tunbridge Wells Agricultural Show, for its automatic tractor tip cart.

The Consolidated Pneumatic Tool Company, Limited, of Egyptian House, 170, Piccadilly, London, W. 1, informs us that it has been appointed sole selling agents in this country for the manufactures of the Duff Manufacturing Company, of Pittsburg, Pa., U.S.A.

Mr. P. Midgley, A.M.I. Mech. E., asks us to state that he has now severed his connection with Gaston, Limited, of Lardenroad, Acton Vale, London, W. 3, and has taken over the position of London manager for Haighs (Oldham), Limited, 117-119, City-road, E.C. 1.

Messrs. Wallis-Jones and Dent, consulting engineers (Reginald J. Wallis-Jones, O.B.E., M. Inst. C.E., M.I.E.E.), ask us to state that they have removed their office from 29, Old Queen-street, S.W. 1, to 50, Queen Anne's-gate, Westminster, S.W. 1, *i.e.*, their pre-war address. Telephone, 8070 Victoria.

EDUCATIONAL INTELLIGENCE.

A Goldsmid Entrance Scholarship of the value of £90 (£30 a year for three years), tenable in the Faculty of Engineering at University College, London, will be awarded on the results of an examination to be held in the last week of September. Entry forms must be sent in to the Secretary not later than September 9th.

CATALOGUES.

A.C.E.C. (Ateliers de Constructions Electriques de Charleroi), 56, Victoria-street, London, S.W. 1.—Illustrated list of motors and dynamos in stock.

F. and A. Parkinson, Limited, Guiseley, Leeds.—Illustrated pamphlet discussing the firm's alternating-current motors and some of their applications.

The Triumph Electric Manufacturing Company, Limited, Steward-street, Birmingham.—Illustrated catalogue of various types of electrically operated fans.

Nobels Industries, Limited, Nobel House, London, S.W. 1. —Illustrated pamphlet, entitled "Metal Breaking with Explosives and other Uncommon Blasting Operations."

Electric Control, Limited, Glasgow ; London office, Hastings House, Norfolk-street, Strand, W.C. 2.—Illustrated descriptive catalogue No. 10A, dealing with automatic electric control gear.

Gwynne's Engineering Company, Limited, Hammersmith, London, W. 6.—Illustrated pamphlet describing the firm's "Invincible" suction dredgers and giving particulars of various works carried out by means of them.

The English Electric Company, Limited, head office, Queen's House, Kingsway, London, W.C. 2.—Publication No. 367, giving particulars and illustrations of turbo-blowers, and publication No. 370, containing a reprint of an illustrated article on "Electric Driving in Scottish Woollen Mills."